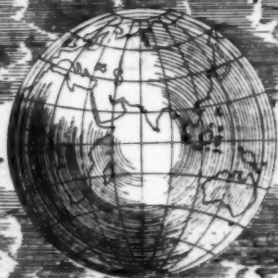


# Current Science



Vol. 26, No. 2

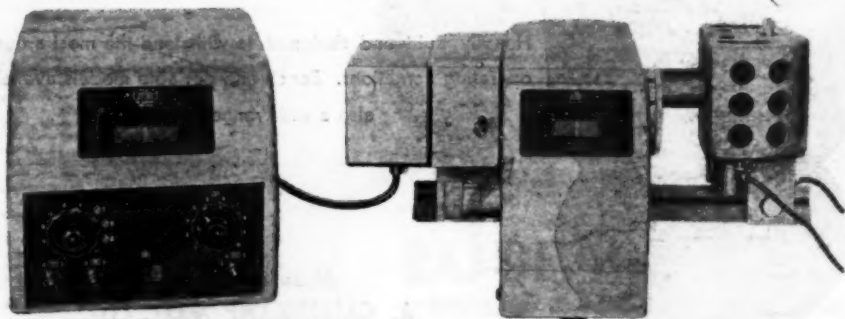
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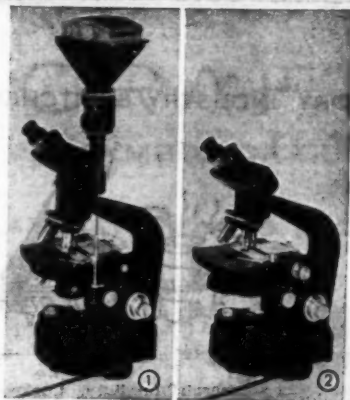
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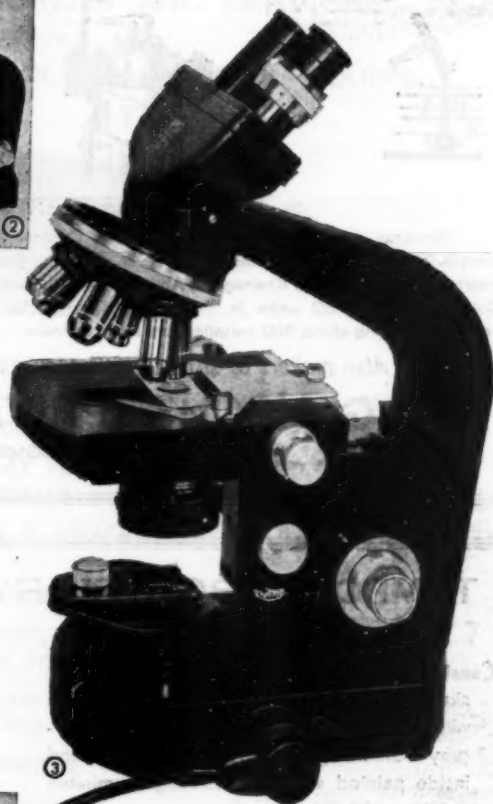


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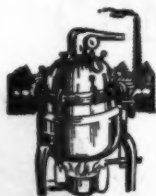
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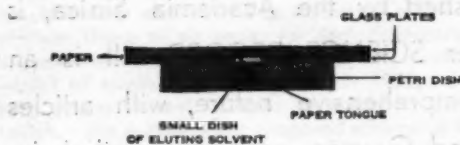
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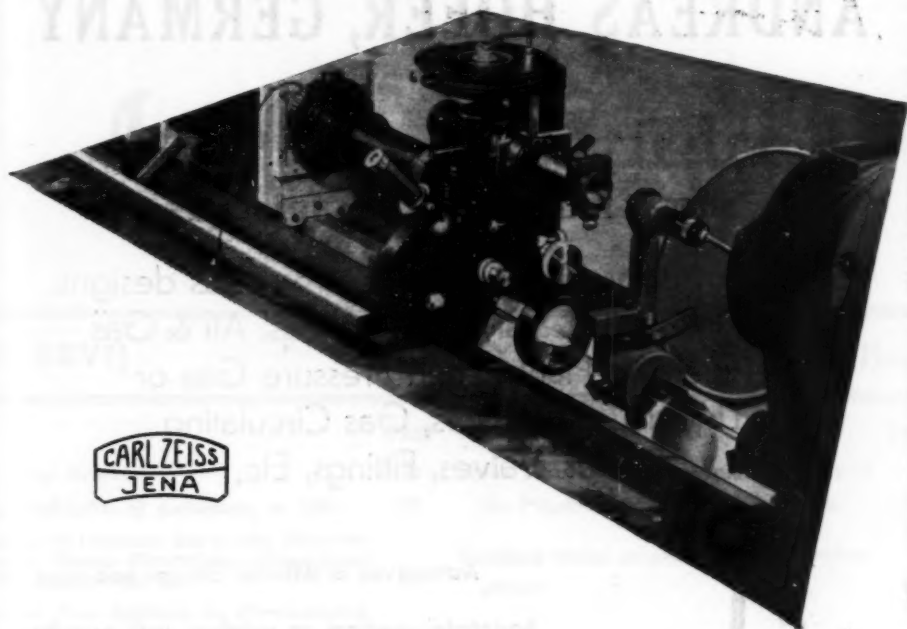
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## ARID ZONE RESEARCH

UNDER its broad programme of mobilising scientific knowledge and technical skills for purposes of a better way of life, UNESCO has been actively encouraging a research project on the arid regions of the earth since 1951, and during its Ninth General Conference held recently in Delhi, it has also resolved to extend the project for six more years. Circulation of research reports on a variety of subjects such as the history of land use in arid regions, modification of soil structure under grazing, dryland and irrigation farming, methods of prospecting and evaluation of water resources, etc., and publication of annual reviews of outstanding work in aridity research—are some of the services envisaged in the project.

arid land problems, with panels of consultants on hydrology, climatology, biology, energy resources and related subjects. Special attention will also be paid for improving research facilities in the various member States co-operating in the project. In addition, two research institutions will be established in the Middle East during 1957 and a number of research fellowships will be awarded to include the Middle East and South Asian countries.

UNESCO's efforts in this direction deserve high praise and will be widely welcomed, for, the arid regions constitute a good third of the earth's land surface—they are nearly three times as large as the presently cultivated area—and reclaiming even a part of this area would seem eminently desirable in view of the growing population of the world and the increasing facilities available today for such purposes.

UNESCO will also encourage the setting up of national or local committees for research on

A fair idea of what can be achieved in this direction can be had from a recent publication\* containing papers and recommendations of the International Arid Lands Meetings. The central problem of land use and human living in arid regions, as Kellogg observes on p. 26, is to maintain a reasonable fit between society and resources, and may be considered as under the following heads: water, soil, plants, animal and man.

In the arid regions, one conserves every drop of water for the maintenance of life, and the only supply is rainfall. Some of the rain soaks into the ground, some runs off in streams, some is evaporated and some is transpired by vegetation. That which is evaporated or transpired by plants may indeed travel great distances but ultimately it falls somewhere as rain, snow, hail, fog or dew, and one of the first problems in the hydrologic cycle of arid areas is that of measuring the precipitation accurately, as also of studying the meteorological conditions most favourable for the artificial inducement of such precipitation. As regards underground water, this calls for exact geological survey of the region with a view to estimate the volume of underground supply, its area, depth and location. Salinity problems also arise in regions where leaching is reduced and salt accumulation occurs.

The soils of arid lands create quite a few problems from the point of view of cultivation because of their low content of organic matter and nitrogen, also from the fact that being more alkaline than acid they give rise to permeability problems during irrigation. Fortunately enough, these characteristics are amenable to suitable fertilizer treatment and it has more or less been proved that crop yields under irrigation can be made reasonably high and large-scale prosperous communities can be established, as in the instances of the U.S.A. and Australia.

The cultivation and maintenance of some suitable plant cover is basic to the development of arid lands, and much experimentation is needed to select the kind of plants with enough 'draught resistance' to carry on with only limited or sporadic water-supply, under conditions of very high day temperatures and low night temperatures. Considerable care is also necessary in choosing the kind of animals suited to such regions. The ecological, genetic

and physiological factors have to be gone into, both in the case of the plants and animals, before a final choice is made.

As regards man himself, good housing is essential—cool by day and of a kind giving adequate protection at night. In this respect, the thick-walled, small-windowed, pig'-houses of the Near East, Pakistan and India would seem to be more or less the types needed. Provision against malnutrition and disease constitutes another important aspect of arid zone research, for dwellers in such regions are peculiarly liable to suffer from a host of diseases arising from the arid conditions.

Perhaps the only main sources of power in the arid regions are the wind and the sun, and it is really surprising how much can be achieved with such limited resources. Successful wind-driven generators up to 70 kilowatts' capacity are operating in Denmark, and two prototypes of 100 kilowatts are functioning in the United Kingdom. Much thought is therefore being given in arid zone research to automatic regulation in variable winds to make the fullest use of wind power for pumping water directly or through the use of electricity, so as to effect a saving in bullock power and thereby the acreage for human food. Solar energy is also being thought of for purposes of cooking and heating water, and efforts are being made to develop a solar engine for a wide variety of purposes.

A perusal of the papers and recommendations in the volume almost makes one agree that the arid regions are not "deserts" so much as "deserted", and one would heartily endorse the recommendation of the Socorro Conference for including the arid belt of the world in the programme of the International Geophysical Year 1957-58. For, though the original plan of the International Geophysical Year has been expanded, the vast arid and semi-arid areas of Africa, Asia, Australia, North America and South America—30° N. to 30° S. principally—are still poorly represented in the list of longitudinal and latitudinal sections fixed for intensive observations. Observations of solar radiation and of other meteorological elements on the surface and in the upper atmosphere in the arid countries—and specifically along a parallel of latitude through as many as possible of the world's deserts—should be a long way in solving many of the problems connected with the development of the arid and semi-arid regions, besides also making the International Geophysical Year even more conclusive and significant.

\* *The Future of Arid Lands*: Edited by Gilbert F. White, Publication Number 43 of the American Association for the Advancement of Science, Washington 5, D.C. 1956, Pp. 464, Price \$ 6.75.

# SOME HIGHLIGHTS OF ASTRONOMY IN 1956

THE American Association of Variable Star Observers has released a compilation of the most outstanding astronomical events of 1956. It is selected by Harlow Shapley, Professor Emeritus at Harvard University and Neilson Professor at Smith College, U.S.A. After commenting that the artificial satellite and the breathless growth of radio astronomy had more or less monopolized the astronomical interest of the scientific public during 1956, Shapley named the following events:

(i) At the top of the list should be mentioned the completion of the prolonged study by Milton Humason of Mount Wilson and Palomar Observatories of the radial velocities of several hundred galaxies, a work upon which we shall for long base our knowledge of the rate of expansion of the universe. The report of the work is published jointly with his colleagues A. R. Sandage and N. U. Mayall of the Lick Observatory.

(ii) Discovery of the antiproton by the nuclear physicists of Berkeley, Calif., which gives to cosmology a basis for strange speculations, as, for example, the suggestion by M. Goldhaber of the Atomic Energy Commission's Brookhaven Laboratory of an anti-matter universe quite distinct and different from our present cosmos—a sort of mirror image of it.

(iii) The beginning of the world-wide organization of amateur astronomers for the visual tracking of the artificial satellite, the launching and study of which is one of the semi-astronomical projects of the International Geophysical Year.

(iv) The firm assurance, after 3 years of exploration and planning, that a large international observatory will be located in the arid South-west, possibly in Arizona, outfitted with an 80-inch reflector and equipment for precise photometry and with the possibility of still larger instruments in the future for the study of the sun, planets and stars. The goal is to provide instruments, chiefly for the use of astronomers located at institutions with unfavourable climates or with small research facilities.

(v) A convincing astrophysical theory by W. A. Fowler and Jesse L. Greenstein of the California Institute of Technology to account for the formation of the heavy elements in stellar interiors—a contribution of high im-

portance in our rapidly increasing knowledge concerning the evolution of stars and of the stellar universe.

(vi) The completion, through publication, of the University of Michigan's great programme of discovery and measurement of southern visual double stars, an enterprise of some 30 years' duration, with R. A. Rossiter as the principal observer; he discovered more than 5,500 new double stars (mostly faint), which establishes a record that probably will never be excelled.

(vii) Detection for the first time of red shifts in the radio spectrum of distant galaxies by A. E. Lilley and E. F. McLain of the Naval Research Laboratory, Washington, D.C., who found the speed of recession of a pair of galaxies (Cygnus A source) the same in the radio wavelength as in the optical measures by W. Baade and R. Minkowski, namely, about 17,000 km./sec.

(viii) Two special conferences of high importance at the McCormack (Va.) and Cook (Pa.) Observatories, the first to pool the continued worries of astronomers about the stellar distance scale and its revision, and the second to explore, with international participation, the future of precision instruments for measuring faint star light.

(ix) The dedication and putting into successful operation, under the general supervision of Bart J. Bok, of the 60-foot radio telescope at the George R. Agassiz Station of the Harvard Observatory, an instrument designed especially for research on the neutral hydrogen radiation of 21-centimetre wavelength, with the structure of the Milky Way spiral arms as one of the principal objectives.

(x) The dominance in the summer and autumn sky of the planet Mars, which was in early September a mere 35 million miles distant, permitting much intense study by spectrograph, photometer, and radio, of the planet's surface at this most favourable approach in many years.

(xi) The announcement from the Canadian Radio Physics Laboratory at Shirley Bay, of Project Janet, a development by P. A. Forsyth and colleagues for using the ionized trains of meteors for the transmission of radio messages over long distances, at least, up to 1,000 miles.

# INFLUENCE OF COMMON ION ON THE DISSOCIATION OF STRONG ELECTROLYTES-BISULPHATES

N. RAJESWARA RAO

Dept. of Physics, Nizam College, Hyderabad

THE Raman Spectrum of a bisulphate solution consists of lines due to  $\text{HSO}_4$  and  $\text{SO}_4$  ions.<sup>1</sup> On adding hydrochloric acid to such a solution, the line due to  $\text{HSO}_4$  ions ( $\alpha_s = 1040$ ) brightens up while that due to  $\text{SO}_4$  ( $\alpha_s = 980$ ) becomes feeble, indicating a recombination of H and  $\text{SO}_4$  ions due to the supply of H ions by hydrochloric acid. But, on adding ammonium sulphate which supplies  $\text{SO}_4$  ions, the line due to  $\text{HSO}_4$  shows a slight decrease in intensity indicating further dissociation of  $\text{HSO}_4$  ions, contrary to what is to be expected from the law of mass action.

A similar result was observed by Hibben<sup>2</sup> in solutions of zinc chloride. In this solution, addition of sodium chloride which supplies Cl ions increases  $\text{ZnCl}_2$  lines, while addition of zinc sulphate which supplies Zn ions has no effect on the intensity of the above line. This was explained by stating that Zn ions having equal affinity for Cl and  $\text{SO}_4$  ions could not influence the dissociation of zinc chloride molecules. A similar explanation cannot be given to what is observed in bisulphate solutions, as the  $\text{SO}_4$  ions form a strong covalent link with H ions to form  $\text{HSO}_4$  ions but a loose electrovalent link in ammonium sulphate molecules.

The subject has been taken up again by the author to observe whether a similar result is reflected in the conductivity data of these solutions. The conductivities of individual components have been determined and are given in Table I.

percentage reduction given in columns 5 and can be taken to be a measure of decrease in dissociation in the mixture. It is seen from Table I that there is no appreciable difference in the influence of H and  $\text{SO}_4$  ions on the dissociation of  $\text{HSO}_4$  ions.

There is apparently a contradiction between the results obtained from the Raman spectra and from conductivity data of these solutions. It is well known that in solutions of high concentrations like 10 N HCl, conductivity indicates a dissociation of 16% while no Raman lines could be recorded for these solutions indicating complete dissociation. To explain the low conductivity of such solutions, Bjerrum<sup>3</sup> assumed that the oppositely charged ions approaching each other to distances less than a particular value could be regarded as forming molecules. Also, in order to explain large heats of dilution, Nernst<sup>4</sup> had assumed undissociated molecules in concentrated solutions even electrovalent salts like sodium chloride and that they progressively dissociate on dilution, the heat of dilution being mostly due to dissociation. In recent years, studies in absorption of ultrasonic waves in liquids have revealed large absorption peaks at certain frequencies, which probably represent loose molecules of low frequencies of the order of a few megacycles. Notable examples are those observed in solutions of sulphur dioxide (M. Krishnamurthi, and in nitrogen peroxide (M. Krishnamurthi and M. Suryanarayana,<sup>5</sup> who

TABLE I\*

	1	2	3	4	5	6	7	8	9
Temp. °C.	$\text{KHSO}_4$ 0.4 M	$(\text{NH}_4)_2\text{SO}_4$ 0.5 M	Sulphate Mixture	1+2-3	4/1 as %	HCl 0.5 M	Acid mixture	1+6-7	8/1 as
2	56.8	42.7	86.7	12.8	22.5	108.7	157.9	7.6	13.4
25	79.4	71.7	131.7	19.4	24.4	159.9	227.8	11.5	14.5
50	88.1	107.9	164.9	31.1	36.1	206.7	271.2	23.6	26.8

\* The figures in Table I represent conductivities in millimhos.

Assuming for the sake of simplicity that the conductivity is proportional to the number of ions, the excess of the sum of the conductivities of the individual components over that of the mixture given in columns 4 and 8 and the

regard the frequency of the peak as representing the frequency with which the molecules dissociate and recombine. These two views do not contradict each other if one takes the oscillations as being maintained by the attractive



ing forces of electrostatic origin and repulsive forces of dissociation, probably due to attraction by the molecules of the solvent. The ultrasonic absorption curve resembles strongly that which gives the probability of energy distributions. Since molecules of this nature cannot be expected to have a sharp frequency, if absorption can be taken to be a function of the number of molecules giving rise to it, the ultrasonic absorption curve gives the distribution of frequencies among various molecules.

It is probable that molecules involving a hydrogen bond between the  $\text{HSO}_4$  ion and the oxygen atom of the water molecule are formed. Since the link  $\text{H}-\text{SO}_4$  in this complex is not always of a covalent nature, it can give lines due to the sulphate ion only. So, the addition of sulphate ion has decreased the dissociation in accordance with the law of mass action, but instead of the formation of stable  $\text{HSO}_4$  ions, complex molecules are formed.

The above discussion still leaves one with the conclusion that  $\text{HSO}_4$  ions are less stable in the sulphate mixture than in the acid mixture. It is generally believed that in oxyacids the ionising hydrogen is attached to the oxygen atom. Hence, ionisation involving a separation of  $\text{OH}$  link leads to a large absorption of heat according to the scheme  $\text{HSO}_4 \rightleftharpoons \text{H} + \text{SO}_4 - \text{heat}$ . On this basis, one expects the dissociation to increase with increasing temperature and also when an acid is diluted with water which helps dissociation, there should be absorption of heat.

But, a study of the dissociation of nitric acid at higher temperatures by the author<sup>6</sup> shows decrease in the dissociation with increasing temperature. Also, as is well known, dilution of nitric acid produces large amount of heat. These results show that there is some other factor which compensates this effect and even makes the reaction exothermic. It is probable that the ions are combining with molecules of water to form  $\text{H}_3\text{O}$  involving evolution of heat.

If the above argument is accepted, the difference in the influence of  $\text{H}$  and  $\text{SO}_4$  ions can be understood, because on adding hydrochloric acid, dilution of the acid takes place which supplies heat favouring recombination of  $\text{H}$  and  $\text{SO}_4$  ions, while when a sulphate is added absorption of heat is taking place which favours progress of dissociation.

The author's thanks are due to Prof. S. Bhagavantam, Vice-Chancellor, Osmania University, for his kind interest and guidance and to Sri. K. Ramabrahmam for help in collecting the data on conductivity.

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## EFFECT OF FREE RADICALS ON CHROMOSOMES IN BARLEY

EARLY work on the radiation chemistry of water and aqueous solutions led investigators to conclude that the hydrogen peroxide found in such solutions might also be present in the cells of irradiated biological material and cause at least some of the genetic and physiological effects of radiation. A recent experiment reported in *Science* (1956, 124, p. 889) in which mutant barley seeds, variety Himalaya, were exposed to  $\text{H}$ ,  $\text{OH}$ , and  $\text{HO}_2$  radicals produced by combining dilute solutions of hydrogen peroxide, has given two results which seem to be of particular interest: (i) Whereas  $\text{H}_2\text{O}_2$  per se is shown to be ineffective in causing chromosomal aberrations, the treatment by the free

radical precursors of  $\text{H}_2\text{O}_2$  resulted in chromosome breakage, (ii) Chemically derived free radicals have much the same effect as irradiation in the production of chromosome aberrations. This aspect gains importance in the light of recent studies that attribute a major role to organic and inorganic free radicals in the X-ray induction of mutations and chromosome damage. The action of these irradiation by-products (indirect effect) is becoming increasingly important in explaining irradiation phenomena that were once attributed solely to a direct effect (target theory) of ionizing radiation.

# SETTING OF HYDRAULIC LIMES AND NATURAL CEMENTS—DIFFERENTIATION OF HYDRAULIC AND PUZZOLONIC FUNCTIONS OF SETTING CHARACTERISTICS

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**T**HOUGH many qualitative relationships between setting characteristics and chemical composition of hydraulic and puzzolonic cements have been established,<sup>1</sup> no quantitative empirical correlation of data has yet been obtained.<sup>2</sup> In the present investigation, a method has been developed to quantitatively evaluate the hydraulic and puzzolonic constants of setting, which may be further used to elucidate the increment of change in setting characteristics that occurs with a small variation in chemical composition.<sup>3,4</sup>

The incorporation of 15-30% aluminium silicate as clayey matter with natural lime induces considerable modifications in its setting characteristics, indicative of a broad differentiation into hydraulic and puzzolonic functions. Under constant operating conditions, it is possible to obtain specific values of these functions capable of being directly correlated with the amount of retarders and other variables.

Experimentally, the setting curves of a large number of naturally occurring hydraulic limes contained in a 4 cm. high Vicat mould were determined by the usual methods.<sup>5</sup> A consideration of the mathematical nature of the curves, obtained by plotting the unpenetrated distance,  $\epsilon$ , against the time period,  $\theta$ , indicated their conformation to the general equation:

$$\theta = a\epsilon^m + b\epsilon^n.$$

With each sample, small variations in amount of water used, ranging from 80-90% on the weight of sample, were found to considerably affect the numerical values of exponential constants, the value of one of them being in all cases greater than unity.

It was our observation that there exists a definite relationship between the values of  $m$  and  $n$ , such that adjustment of water percentage to a proper level in all cases reduces the general equation to the form:

$$\theta = a\epsilon^2 + b\sqrt{\epsilon}.$$

It is also found, moreover, that at  $m=2$ , a definite percentage of water is used, depending upon chemical composition and the results obtained with larger amounts of water are not capable of exact reproducibility. Fig. 1 shows three typical curves, obtained by using 83%,

82% and 85% water with samples A, B and respectively. Since the slope of the curve, given by its first derivative

$$d\theta/d\epsilon = 2a\epsilon + \frac{1}{2}b\epsilon^{-1/2}$$

passes through a minimum at the point of flexion

$$d^2\theta/d\epsilon^2 = 2a - \frac{1}{4}b\epsilon^{-3/2}.$$

Hence

$$\theta = 0.5625 a^{-1/2} b^{2/3} \text{ and } \epsilon = \left(\frac{b}{8a}\right)^{2/3}$$

at this point, which is indicative of what may be defined as the maximum set point. The co-ordinates of this point ( $\theta'$ ,  $\epsilon'$ ), uniquely determined by the constants  $a$  and  $b$ , are graphically evaluated by plotting  $d\theta/d\epsilon$  against  $\theta$  or  $\epsilon$ . Since there is no sudden hardening, the slope at  $\theta'$ ,  $\epsilon'$  is not asymptotic to the  $\epsilon$ -axis but is given by the expression  $1.50 a^{1/2} b^{1/3}$ .

It is found that the puzzolonic-set characteristic function,  $\theta_1$ , and the hydraulic-set characteristic function,  $\theta_2$ , may be expressed in the form  $\theta = \theta_1 + \theta_2$ , where  $\theta_1 = a\epsilon^2$  and  $\theta_2 = b\sqrt{\epsilon}$ . At the maximum set point,

$$8\theta_1 = \theta_2 \text{ and } a\theta^3 = 0.178b^4.$$

These characteristic functions are thus determined by the independent variables  $a$  and

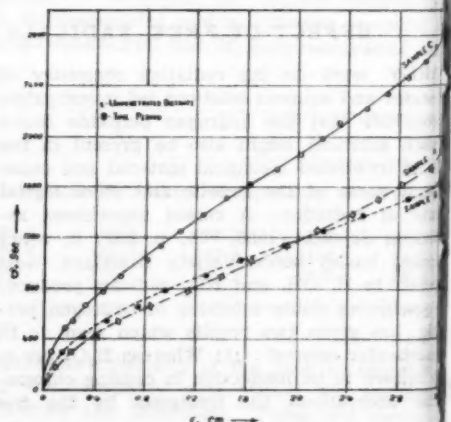


FIG. 1. Graph between time period ( $\theta$ ) and unpenetrated thickness ( $\epsilon$ ).

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They may be numerically evaluated by solving the general equation

$$\theta = a\epsilon^2 + b\epsilon$$

for the two sets of experimental values of  $\theta$  and  $\epsilon$  from a setting curve, preferably in proximity to the maximum set point, or approximately by substituting the values of  $\theta_i$ , the initial setting time, and  $\theta_f$ , the final setting time, in the following equations:

$$a = 0.0654 \theta_f - 0.1850 \theta_i$$

$$\text{and } b = 5.918 \theta_f - 0.925 \theta_i$$

Experimental values for these functions have been obtained in a number of cases. Under specified operating conditions, these, such as are given in Table I, may be related to the chemical composition of a particular series of hydraulic limes.

TABLE I  
Differentiation of setting characteristics

Sample	Water %	Max. set point		Characteristic Functions at $\theta, \epsilon$		$a$	$b$
		$\theta'$ Sec.	$\epsilon'$ cm.	P-Set $\theta_1$	H-Set $\theta_2$		
A	83	812	1.2	90	722	62.7	659
B	82	1223	2.1	130	1087	30.8	750
C	85	1598	1.6	178	1420	69.4	1123

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## SOME THEORETICAL AND APPLIED ASPECTS OF THE PHYSIOLOGY OF UNSTRIATED MUSCLE\*

COMPARATIVELY speaking, more attention has been devoted by physiologists to striated than to unstriated muscle, though the disorders of former muscles are rarer. We are ushered into this world by the contraction of unstriated muscle, and disorders of the unstriated muscle of the alimentary canal and other tubular structures are common ailments. The modern stress and strain of life leads to the contraction of the unstriated muscle of the blood vessels, which in turn damages the kidneys and the heart, so that the problem of heart disease in coronary attacks is really the problem of blood vessels and their smooth muscle. Similarly, some disorders of the nervous system are due to vascular spasm, local and general.

### CHEMICAL COMPOSITION OF UNSTRIATED MUSCLE

Interest in this subject has increased in recent years owing to its relation to hypertension. It is now generally recognised that ionic imbalance results in hypertension. Sodium causes contraction of the contractile mechanism by direct effect on its proteins. Retention of sodium would therefore result in hypertension. Intracellular potassium, besides being a suitable medium for the actomyosin system of the muscle, also maintains the normal excitability.

Potassium has a relaxing effect on the contractile mechanism of unstriated muscle, so that the fall of blood pressure due to retention of potassium is likely to be due to this effect. Intracellular calcium would be responsible for accommodation or adaptation of muscle. Calcium also causes contraction of the contractile mechanism. As there is a natural increase of lime salts in the arteries of the aged, the action of calcium might be responsible for the physiological increase of blood pressure with age. Calcium also causes extrusion of sodium.

### EXCITABILITY

Unstriated muscle can be stimulated both electrically and chemically but in some unstriated muscles the properties of these two types of responses differ whether they be inhibitory or excitatory. In these muscles, therefore, it is possible to decide whether a particular response has been produced by electric current or a chemical substance. The application of this finding can be used to decide between the electrical and chemical theory of nerve transmission in certain situations. It is possible to say, therefore, whether a particular response has been produced by the action potentials of the nerve or by some humoral substance secreted by it. Experiments on the nerve-smooth muscle preparation of dog's and frog's stomach suggest that the action of the vagus nerve is produced by secretion of acetylcholine, and

\* Abstract of the Presidential Address of Dr. Inderjit Singh to the Section of Physiology, 44th Session of the Indian Science Congress, 1957.

not by the action potential of the nerve, as the response produced by nervous stimulation resembles that produced by a chemical substance.

The effect of various ions on unstriated muscle is well known. A somewhat different behaviour of some unstriated muscles is their ability to preserve their excitability in the absence of sodium, or even all electrolytes. Overton found that frog's striated muscle becomes inexcitable in a few minutes if it is immersed in an isotonic solution of sucrose. Frog's stomach muscle does likewise, but if the osmotic pressure of the sucrose solution is reduced by 30% to 40% (0.112 M), then after an initial depression the muscle recovers and remains irritable for several hours.

When the muscle is contracting strongly, chemical analyses show that it does not contain any significant amount of sodium. This is contrary to the action of sodium in nerve, but as the nature of excitability in general ought to be the same in all tissues, these experiments appear not to support the ionic hypothesis.

Action potentials can be reached from the muscle in hypotonic sucrose solution. This shows that no electrolyte is necessary in the external medium for the production of these potentials.

#### ACTION OF CHOLESTEROL

Cholesterol is deposited in the intima of the blood vessels in atheroma. The muscular coat may also contain it in excessive amounts, as there is no likelihood of any diffusion barrier between the intima and the other coats of the blood vessels. The question arises whether cholesterol acts as an inert substance, or whether it can cause tonic contraction of the arterioles. Cholesterol appears to cause constriction of blood vessels. This finding is of importance, as it would explain coronary attacks in the absence of sufficient atheromatous changes if there is hypercholesterolaemia. It would also explain the incidence of coronary attacks which occur after a meal. After a meal, there may be a rise in the lipid, hence the cholesterol content of blood, and this may precipitate an attack.

#### METABOLISM OF UNSTRIATED MUSCLE

Metabolism in unstriated muscle usually follows the pattern found in striated muscle, but there are important exceptions. Unstriated muscle shows two types of contractions. One kind of response is accompanied by increase and the other by decrease in lactic acid production. The oxygen consumption also shows similar variations. Corresponding to this there

are two kinds of relaxations, one being followed by increase and the other by a decrease in the production of lactic acid or oxygen consumption. It is clear, therefore, that we are dealing with two contractile systems in this muscle, in one the relaxation being active and in the other, passive. These two kinds of relaxation can be differentiated by the action of substances which suppress metabolism. Thus sodium cyanide, iodoacetic acid, sodium azide, decrease active relaxation but increase passive relaxation.

#### ANTAGONISM BETWEEN ACTIVE AND PASSIVE RELAXATION OF MUSCLE

These two kinds of relaxation are antagonistic. This is shown by the fact, that in certain solutions, the muscle relaxes more if unloaded, than if it is loaded. This is due both to the excitatory and the contractile mechanism as it is also shown by muscle in which the excitatory mechanism has been destroyed by heating.

The existence of the two systems in some unstriated muscle can be shown directly. Thus, if the unloaded heat-killed muscle is heated to 60-70° C., then it relaxes. The supply of energy to the contractile mechanism thus causes active relaxation. If once the muscle is heated to 70° C., then active relaxation is permanently inactivated. It now gives a contraction which is proportional to rise in temperature, and the relaxation is passive. The supply of energy to the contractile mechanism, therefore, now causes proportionate contraction. In some muscles, therefore, both contraction and relaxation are energised.

#### RELATION BETWEEN MUSCULAR CONTRACTION AND DENATURATION OF PROTEINS

Denaturation of protein is supposed to consist of an alteration of the specific internal structure of the protein wherein the closely folded peptide chains unfold. Similarly, the contraction of muscle is supposed to be due to folding of the contractile protein; thus, relaxation would be due to the unfolding of the muscle proteins and the process of relaxation of muscle would be similar to the denaturation of proteins. The similarity between the two processes is shown by the fact that many agencies, both physical and chemical, which denature proteins also cause active relaxation of heat-killed unstriated muscle.

In the mechanism of enzymatic hydrolysis, it is presumed that the proteolytic enzyme at first denatures the protein. This action of the enzyme can be tested on the heat-killed un-



striated muscle. It has been found that active relaxation is produced by trypsin and papain, but not by pepsin. In the case of pepsin, the active relaxation is produced by the hydrochloric acid medium. These experiments therefore indicate that hydrolysis of proteins by enzymes is preceded by the unfolding of the polypeptide chains. This might be done by the enzyme itself, or by the medium in which the enzyme acts.

#### TONUS IN UNSTRIATED MUSCLE

During tonic contraction it may be presumed that the unfolding of the polypeptide chains is prevented by the development of cross-linkages between the chains. The nature of these linkages can be ascertained by treatment of the heat-killed muscle with various reagents. There appear to be at least three types of such bonds: (a) hydrogen bonds, (b) S-S linkages, (c) salt linkages. The presence of hydrogen bonds is shown by the active relaxation produced by urea, distilled-water and heat. The presence of S-S linkages is shown by the active relaxation produced by sodium cyanide, sodium sulphide and sodium sulphite. Salt linkages are indicated by relaxation produced by salts.

One kind of tone in unstriated muscle can be mechanically destroyed without affecting the phasic response. The lateral bonds are thus mechanically ruptured. The phasic response shows that the folding of the polypeptide chains remain unimpaired. It is difficult to conceive of normal folding of the polypeptide chains when some of their lateral branches have been destroyed by such a procedure as sudden stretching. It is therefore reasonable to assume that the phasic response is produced by a different set of polypeptide chains. In the muscle, therefore, there appear to be two sets of polypeptide

chains, one for phasic and the other for tonic contraction. It is possible that the tonic mechanism relaxes actively, as the rupture of cross-linkages chemically results in active relaxation. This is also shown by the fact that this kind of tone is unaffected by asphyxia, and results in diminished production of lactic acid and decreased consumption of oxygen.

Unstriated muscle, however, shows a second kind of tone, the mechanical reduction of which also reduces the phasic response. This kind of tone, therefore, is produced by the same system of polypeptide chains which fold to produce the phasic response. This kind of tone is reduced by asphyxia, and is accompanied by increase in the production of lactic acid and more oxygen consumption. But in this system also the polypeptide chains can be maintained in folded condition by the development of cross-linkages, as in *Mytilus* muscle, both the phasic and the tonic responses are reduced by mechanical disruption, but the tone is not affected by asphyxia. In this system relaxation appears to be passive.

#### PERMEABILITY OF UNSTRIATED MUSCLE

The permeability of unstriated muscle to the monovalent ions varies in the order: Li, Na, NH<sub>4</sub>, K and to anions, in the order Cl, Br, NO<sub>3</sub>, SCN, CN. The stimulating power of these ions also varies in the same order. Calcium appears to cause extrusion of sodium. This might be concerned in the mechanism of absorption and secretion of electrolytes by cells. On the absorbing side, there would be diminished concentration of calcium. On the secreting side of the cell, the arrival of the electrolyte might liberate calcium, which in turn might extrude the electrolyte.

### RUMFORD MEDAL AWARD TO DR. S. CHANDRASEKHAR

THE Rumford Medal for Scientific Research in the Fields of Heat and Light has been awarded to Dr. S. Chandrasekhar, Faculty of Theoretical Astrophysics, University of Chicago, and will be presented at a Meeting of the American Academy of Arts and Sciences in Boston on March 13.

Dr. Chandrasekhar will receive the medal for "extending to the cosmic realm the stochastic laws which, on the atomic scale, govern the

phenomenon of heat", and for his monumental work on radiative equilibrium in stellar atmospheres.

In 1935, the same medal was awarded to James Franck and in 1953, to the late Enrico Fermi. It may be recalled that Dr. Chandrasekhar won the Bruce Medal of the Astronomical Society of the Pacific in 1952, and the Gold Medal of the Royal Astronomical Society, London, in 1953.



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## ON THE ELECTROLYTIC PREPARATION OF METALLIC FILMS FOR ELECTRON MICROSCOPIC STUDIES

THE present work describes a method for the preparation of electrodeposited metallic films for studying the size and distribution of grains of the electrodeposits by transmission examination in the electron microscope.

It has been reported by Koenig<sup>1</sup> and Koenig and Helwig<sup>2</sup> that charged particles and short-wave radiations can cause dissociation of compounds containing hydrogen. The polymerization products will in turn be transformed into carbon if electron bombardment is continued. High conductivity graphite can also be obtained if the intensity of the electron beam is stepped up, as suggested by Koenig.<sup>3,4</sup> Thus it appears that a collodion film may be transformed into carbon if the former is subjected to electron bombardment.

In the present experiment, a blank stainless steel mesh, mounted on a brass eyelet was covered with a collodion film (50-60 Å), which after being dried was subjected to electron bombardment in the electron-microscope at a beam current of 20 microamps. for 20 minutes. The collodion film did not show any rupture or fracture when examined in optical microscope before and after bombardment.

As a sufficiently thin metallic film is suitable for the transmission examination in electron microscope, a dilute electrolyte seems convenient. The electrolyte bath was prepared by mixing one volume of Solution No. 1 and four volumes of Solution No. 2. Solution No. 1: Gold chloride containing 1 g. of Au per 100 ml. of solution. Solution No. 2: 1.2 ml. conc. nitric acid and 3.2 ml. ethyl alcohol in 100 ml. of solution. For silver deposits, gold chloride in Solution No. 1 was replaced by silver nitrate.

Electrodeposition of gold was carried out with the electrolyte as stated above on a freshly bombarded collodion film, about 0.4 cm.<sup>2</sup>, obtained by the technique described above. The deposit of Au thus obtained at a total current strength of 0.6 milliamps, for 10 minutes was photographed in the electron microscope and shown in Fig. 1. A similar silver deposit was obtained under identical conditions.

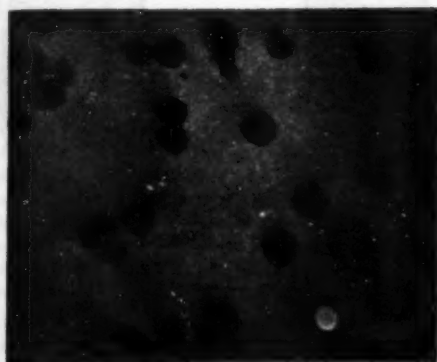


FIG. 1. Electron Microphotograph of Au deposit at 0.6 ma,  $\times 2800$ .

The photograph shows that gold grains have nearly circular cross-sections and at the same time give an idea about the distribution of the grains. This remark also applies to the deposit of silver.

The work was carried out at the Institute of Nuclear Physics, Calcutta University.

Applied Physics Dept.,

D. N. KUMAR.

Calcutta University,  
Calcutta, October 30, 1956.

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### MARINE TRANSGRESSIONS IN GODAVARI DELTA

DURING the course of an investigation of the occurrence of natural gas in parts of Godavari Delta sponsored by the Government of Andhra during 1955-56, four bore-holes were put down at Pedapatnam Agraharam (150 ft.), Thatipaka (200 ft. and 325 ft.), and Amalapuram (200 ft.). Other localities in the adjacent regions where occurrence of natural gas was reported, were also visited and data collected where possible

(Pulapalle). Alternating layers of unconsolidated sand and silt with occasional intercalations of peaty and lignitic material were met with in the bore-holes. Fragments of fresh-water shells which are generally very thin and fragile, were also found to be mixed up with the sand and silt.

In two zones in the bore-holes, however, there was found a remarkable concentration of shells of a different type. The zones are: Pedapatnam Agraharam: 35-52 ft. and 70-100 ft.; Pulapalle\*: 45-50 ft.; Thatipaka: 104-124 ft.; Amalapuram: 84-108 ft.

The shells in these zones are considerably thicker-valved in contrast to the thin and fragile fragments met with in the rest of the column in the bore-holes. They belong to the phylum Mollusca and are all Lamellibranchs. They are identified as *Arca ventricosa*, *Arca tortuosa*, and as species of *Anomia*, *Placuna* and *Oyster*. They are known to be marine and sometimes estuarine with a range in time from Miocene-recent to present.

The sand samples containing these shells, on mechanical analysis, show a single maxima in the 100 mesh and have sorting coefficients ranging from 1.119 to 1.602, showing that the sands are very fine-grained and well-sorted.

The occurrence of the shells in these zones and their marine and/or estuarine nature, to the entire exclusion of fresh-water types, are interesting. In deltaic regions, generally, one would expect to find a combination of marine and fresh-water conditions reflected in the sediments. Under this set-up, at least some fresh-water shells would have found their way into these zones. Secondly, if the sand is a characteristic deltaic deposit formed by the intermixing of the sediments of the stream and of the sea, this would have been reflected in the size analysis by yielding two maxima. It is therefore suggested that temporary marine transgressions in the deltaic region gave rise to the shell zones described above. These results are of significance in the studies of the evolution of the deltaic area of the Godavari, with particular reference to the occurrence of peat, lignite and natural gas in the area.

The author owes grateful thanks to Professor C. Mahadevan for his guidance and interest in the work.

Dept. of Geology,  
Andhra University,  
Waltair, November 14, 1956.

B. B. G. SARMA.

\* The sample from Palapalle was collected by T. V. S. R. Kshirasagar of this Department.

# JOINTING IN DOLOMITIC MARBLE OF BHERA GHAT, JABALPUR DT. AND ITS RELATION TO PREFERRED ORIENTATION

THE Nerbada River at Bhera Ghat about 13 miles west-south-west of Jabalpur City flows through white glistening marbles interbedded with phyllites and chlorite-schists and associated with epidiorites for a distance of over 2 miles, the whole stretch being popularly known as the 'Marble Rocks'. The marble, the fabric of which is under investigation, is for the most part pure dolomite though here and there it is micaceous, talcose and tremolitic. It is conspicuously bedded, the strike of the bedding plane ( $S_1$ ) varying between  $80^\circ$  and  $110^\circ$ , the dip being southerly and steep ranging between  $50^\circ$  and  $70^\circ$ . Foliation is distinct wherever the rock is micaceous. Of the megastructures simple monoclinical flexures and other minor folds in addition to joints are the most important. The axis of folding trends nearly north-south. Three sets of joints are well developed and these have given rise to other subsidiary joints which are somewhat irregular. The first set of joints, here called  $S_2$ , is a strike joint mostly horizontal but in places with a northerly dip up to  $15^\circ$ . The second set,  $S_3$ , strikes  $45^\circ$  with a south-easterly dip of about  $40^\circ$ , while the third,  $S_4$ , has a strike of  $135^\circ$  the dip being about  $40^\circ$  to the south-west. The last two sets are oblique joints constituting a conjugate system.

The oriented microsections of the marble exhibit clearly the mosaic texture; examination of the mineral as described by Emmons<sup>1</sup> showed it to be dolomite. While the rhombohedral cleavage is distinct, twinning is not common. A plot of the poles of the optic axis,  $C$ , of the mineral from an oriented marble is given in Fig. 1 along with the mega-structural features. It can be seen that the maxima constitute a girdle nearly normal to the fabric axis  $b$ . The circular arcs of the two oblique joints intersect at B. Considering joints as parallel to the planes of maximum tangential stresses,<sup>2</sup>  $bB$  represents the axis of intermediate principal stress. The other two principal axes lie in a plane normal to  $bB$  and emerge on the great circle of which B is the pole. The dihedral angle between the two joints as measured on this great circle is  $114^\circ$ , and the point of bisection of this arc at A gives the position of the pole of the axis of the least principal stress as it lies in the obtuse angle between the joint planes.  $90^\circ$  away from it on the great circle emerges at A the axis of the

greatest principal stress which lies only  $1^\circ$  from the  $ac$  plane.

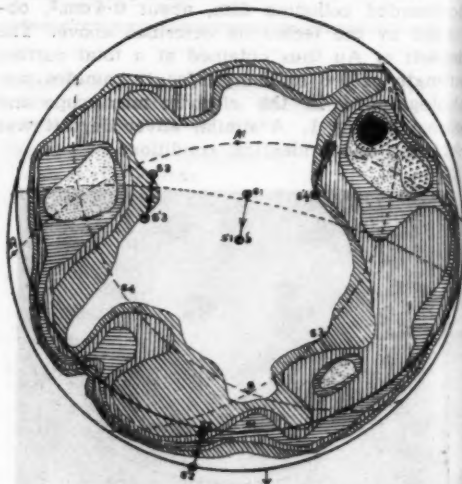


FIG. 1. Orientation diagram for Dolomitic Marble Bhera Ghat. Optic axes of 100 grains of dolomite along with joint planes and their poles. Contours at 6%, 5%, 4%, 3%, 2%, 1% per 1% area.

To understand the relationship between the structural features and deformation pattern, the pole to the strike plane  $S_1$  is made to coincide with the  $b$  fabric axis by rotation, which in Fig. 1 is to the south by an angle of  $14^\circ$ . Likewise the poles of  $S_2$ ,  $S_3$  and  $S_4$  respectively change to  $S_2'$ ,  $S_3'$  and  $S_4'$ . It is then seen that the poles of the diagonal joints, namely,  $S_3'$  and  $S_4'$  come to lie on the axes joining the diagonal maxima while  $S_2'$  becomes peripheral. From these facts it is concluded that (1) the diagonal joints controlled the formation of diagonal maxima, and (2) the strike joint controlled the peripheral girdle maxima. Thus, the mega-structures of the marble seem to be the external manifestations of the lattice-orientation of its dolomite crystals.

The full details of the work will be published elsewhere.

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# PREPARATION OF ALUMINIUM SUCCINATE JELLIES

ALUMINIUM SUCCINATE has been described<sup>1</sup> as a dense white precipitate and can be obtained by treating a solution of sodium succinate with aluminium chloride solution. In previous communications<sup>2,3</sup> from these laboratories the preparation of ferric and zirconium succinate jellies were described. We have now succeeded in preparing aluminium succinate jellies and in this communication the conditions of their preparation are reported.

The jellies have been prepared by the metathetical reactions between aluminium chloride and sodium succinate. An aluminium chloride solution containing 99.95 g. of aluminium oxinate,  $Al(C_2H_3O)_3$ , per litre and a 3M/20 sodium succinate solution was found to give the best jellies. To 2.5 ml. of the aluminium chloride solution were added different amounts of the sodium succinate solutions. The total volume was kept 7.0 ml. in each case. The mixtures were shaken for 30 seconds and then allowed to stand in a bath maintained at 32°C. The influence of the varying amounts of sodium succinate on the time of setting of the jellies may be seen from Table I.

TABLE I

Showing the relation between amount of sodium succinate present and the time of setting of the jellies

Amount of sodium succinate in ml.	Time of set min.
4.5	50
4.3	80
4.1	113
3.9	146
3.7	186
3.5	235

These jellies are of very fine texture, highly transparent, firm and very stable. They do not exhibit any syneresis and maintain their transparency even when kept for a long time. They set more readily at higher temperatures and are very similar to aluminium molybdate jellies investigated by one of us.<sup>4</sup>

Further work on these jellies is in progress.

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# IODINE BROMIDE CATALYSED BROMINATION OF AROMATIC COMPOUNDS

FOLLOWING the investigations by Robertson,<sup>1</sup> Bruner<sup>2</sup> and Tsuruta *et al.*<sup>3</sup> on the mechanism of iodine catalysed bromination of mesitylene, benzene, etc., we have investigated the bromination of phenol with bromine and iodine bromide, and have come to the conclusion that the rate of bromination is adequately represented by

$$\frac{d[ArBr]}{dt} = k.K. [ArH] [Br_2] [IBr]^m, \quad (1)$$

in which ArBr stands for the aromatic bromo-compound. This equation perforce excludes a few equilibria assumed by Tsuruta *et al.*<sup>3</sup> as superfluous.

The mechanism proposed by Tsuruta *et al.*<sup>3</sup> assumes the bromination to be catalysed not by iodine but by IBr, the rate-determining step being,



in which HBr is removed, under the catalytic influence of IBr, from a 1:1 aromatic bromine molecular complex, the existence of which has been confirmed by spectroscopic studies,<sup>4</sup> and  $m$  is an integer.

According to Eq. (1) it would appear: (i)  $Y/X = m/m + 2$  and not  $m/m + 1$  as deduced by Tsuruta *et al.*<sup>3</sup> Here  $X$  and  $Y$  represent the initial molar concentrations of bromine and iodine respectively; (ii)  $m$  is unity for the bromination of phenol in carbon tetrachloride; (iii) using the values of  $m$  given in literature,<sup>5</sup> it is found<sup>6</sup> that the values of  $Y/X$  at the catalytic maximum for bromination of aromatic compounds are in excellent agreement with the observed values<sup>1,2</sup> on the basis of our scheme.

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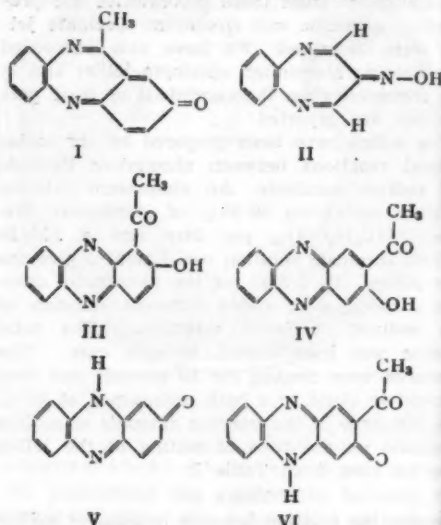
# CONDENSATION OF *o*-PHENYLENE DIAMINE WITH 2-ACETYL-*p*-BENZOQUINONE

DURING investigations on quinones as intermediates for building up of heterocyclic ring systems, *o*-phenylene diamine was reacted with 2-acetyl-*p*-benzoquinone to synthesise a new compound (I) containing a seven-membered ring—a heterocyclic analogue of benzodiazatropone. In view of recent publications of Barry *et al.*,<sup>1</sup> Stafford, Reid and Barker,<sup>2</sup> and Lloyd and Marshall<sup>3</sup> it seemed necessary to record our preliminary results.

Theile and Steimming<sup>4</sup> prepared benzdiazine by the condensation of *o*-phenylene diamine and acetylacetone. Schwarzenbach and Lutz<sup>5</sup> used ethylene diamine and acetylacetone while Lloyd and Marshall<sup>3</sup> used trans-1:2-diaminocyclopentane and acetylacetone to obtain the corresponding diazepines. Stafford, Reid and Barker<sup>2</sup> have gone a step further and used nitromalondialdehyde and isonitroso-acetylacetone for condensation with *o*-phenylene diamine to build up benzdiazatropone structure (II). 2-Acetyl-*p*-benzoquinone can be compared with  $\beta$ -dicarbonyl compounds used above and on condensation with *o*-phenylene diamine may furnish directly compounds similar to benzdiazatropone and hence the reaction was carefully studied.

To a solution of 2-acetyl-*p*-benzoquinone (1.5 g., 2 ml.) dissolved in dioxane (40 c.c.) was added dropwise over a period of 15 to 20 minutes at room temperature (30°) a solution of *o*-phenylene diamine (0.54 g., 1 ml.) in dioxane (15 c.c.). A little rise in temperature indicating that the condensation was taking place was observed. After two hours, water was added dropwise until a permanent turbidity appeared. The mixture was allowed to cool in a refrigerator when after about five hours yellow silky needles separated, m.p. 155–156° C. On recrystallisation from rectified spirit a compound, A, m.p. 157° C., was obtained. It is soluble in alkali and gives alcoholic ferric chloride colouration. Found: C, 70.20; H, 4.26; N, 12.1; mol. wt. 212, 215 (Rast.).  $C_{14}H_{10}N_2O_2$  requires: C, 70.5; H, 4.2; N, 11.7; mol. wt. 238. The monoacetate was prepared by refluxing it with pyridine-acetic anhydride and crystallised from rectified spirit, m.p. 142° C.; gave no ferric chloride colouration as expected. Found: C, 68.05; H, 4.05; N, 9.71;  $C_{16}H_{12}N_2O_3$  requires C, 68.57; H, 4.28; N, 10.00; 2:4-dinitrophenylhydrazine recrystallised from acetic acid, m.p. 270° C. Found: C, 57.1; H, 3.4; N, 20.2;  $C_{20}H_{14}N_6O_8$  requires C, 57.41;

H, 3.35; N, 20.09; hydrochloride prepared by passing dry hydrochloric acid gas in dry ethereal solution of A; m.p. 162° C. (decomp.); on boiling it with alcohol the compound A is regenerated; found: C, 61.5; H, 4.05; N, 10.3; Cl, 11.8;  $C_{14}H_{11}N_2O_2Cl$  requires C, 61.2; H, 4.00; N, 10.2; Cl, 12.93.



On the basis of chemical properties and analytical results the compound A is tentatively assigned a phenazine structure (III) or (IV) or their *p*-quinone analogues (V) or (VI) similar to aposofranone.<sup>1</sup> Formation of phenazines from  $\beta$ -quinones is well known but to our knowledge this is the first instance wherein the formation of the phenazine derivative has taken place even from *o*-quinone.

If one molecule of 2-acetyl-*p*-benzoquinone and three molecules of *o*-phenylene diamine are used in the above condensation the major product of the reaction is a compound B, m.p. 208° C. It is a brick-red crystalline solid sparingly soluble in organic solvents, soluble in alkali and gives red colouration with alcoholic ferric chloride. Found: C, 72.1; H, 5.5; N, 16.5;  $C_{20}H_{18}N_4O$  requires: C, 72.72; H, 5.4; N, 16.96. From the empirical formula it appears that two molecules of *o*-phenylene diamine are involved in condensation with one molecule of the quinone.

Experiments to elucidate the structure of B are in progress and would be reported later. If 3:5:6-trisubstituted 2-acetyl-*p*-benzoquinone is used instead of 2-acetyl-*p*-benzoquinone *o*-phenylene diamine may condense so as to form a seven-membered ring compound



analogous to benzodiazatropone (I). Investigations in this direction are also in progress.  
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Bombay-1, December 6, 1956. A. B. KULKARNI.

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### THE SYSTEM LITHIUM SULPHATE-LITHIUM NITRATE-WATER AT "[30° C.]" AND 35° C.

This system was investigated by Massink<sup>1</sup> who reported that two double salts, namely, (i)  $\text{LiNO}_3 \cdot 9\text{Li}_2\text{SO}_4 \cdot 27\text{H}_2\text{O}$ , and (ii)  $\text{LiNO}_3 \cdot 11\text{Li}_2\text{SO}_4 \cdot 17\text{H}_2\text{O}$ , and also anhydrous lithium sulphate existed in this system as solid phases at 35°, but not at 25°. The 35° solubility isotherm of Massink appears to be incorrect, because (i) the existence of such double salts is not in accord with the behaviour of similar systems of other metals; (ii) two separate domains of existence for lithium sulphate monohydrate—with the saturation fields of the double salts lying in between them—were observed by Massink. This type of phase distribution is seldom met with in aqueous salt sys-

tems; and (iii) the occurrence of anhydrous lithium sulphate as a solid phase at 35° is improbable because lithium sulphate monohydrate is quite stable at this temperature as its transition temperature<sup>2</sup> to the anhydrous form is quite high, and as it is not dehydrated even in presence of lithium chloride,<sup>3</sup> alcohol<sup>4</sup> or 55% sulphuric acid.<sup>5</sup> A reinvestigation of the ternary system was therefore deemed worthwhile and hence the phase relationships were re-determined at 30° and 35° respectively.

Lithium sulphate (in both anhydrous and hydrated forms), lithium nitrate and water were taken in desired proportions and the mixtures were stirred up for equilibrium at 30° and 35°, in the solubility apparatus recently described by Aravamudan and Krishnaswami.<sup>6</sup> The thermostatic temperatures were set accurately with the aid of certified thermometers that were checked against the transition temperature of sodium sulphate decahydrate. The saturated solution and the wet residue were analysed for their lithium nitrate and lithium sulphate contents separately. The composition of the solid phase was ascertained graphically by Schreinemaker's<sup>7</sup> 'wet rest' method and also by an algebraic method which was as follows:

The solid phase is assumed to possess different probable values for its water content, namely, (A) 0%, (B) 14.06%, (C) 31.46%, and (D) 19.31%, which theoretically correspond to those in (A) anhydrous lithium sulphate, (B) lithium sulphate monohydrate, (C) double salt (i), and (D) double salt (ii) respectively. If  $S_1$ ,  $N_1$ ,  $W_1$  denote the weight

TABLE I  
"[ $\text{Li}_2\text{SO}_4$ — $\text{LiNO}_3$ — $\text{H}_2\text{O}$ ]" at 35° C.

100 g. saturated solution contain		100 g. wet residue contain		Solid phase (Graphical Method)	$W_s = 0\%$ $S_s = A$	14.06% B	31.46% C	19.31% D	Solid phase (Algebraic Method)
$\text{Li}_2\text{SO}_4$	$\text{LiNO}_3$	$\text{Li}_2\text{SO}_4$	$\text{LiNO}_3$						
25.19	..	..	..	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$	..	..	..	..	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
14.78	10.13	57.22	4.10	do	..	85.95	65.65	79.83	do
10.83	14.72	59.67	5.13	do	..	85.98	64.34	79.54	do
3.61	25.75	48.94	11.62	do	..	85.83	60.54	78.18	do
0.89	35.30	60.12	10.68	do	..	86.02	..	77.05	do
0.20	44.52	60.78	12.94	do	..	86.32	..	75.34	do
0.05	55.04	61.79	15.37	do	..	86.40	..	71.85	do
0.04	59.19	47.84	26.25	do	131.2	85.82	..	..	do
0.03	60.98	49.71	25.63	do	134.8	86.10	..	..	do
0.03	61.87	11.09	62.72	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ + $\text{LiNO}_3$	..	..	..	..	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ + $\text{LiNO}_3$
..	61.93	..	..	$\text{LiNO}_3$	..	..	..	..	$\text{LiNO}_3$

$W_s$  = Assumed values for weight per cent. of water in experimental solid phase, variously corresponding to those in (A)  $\text{Li}_2\text{SO}_4$ , (B)  $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ , (C) Double salt (i), (D) Double salt (ii).

$S_s$  = Calculated values for weight per cent. of lithium sulphate in experimental solid phase for different  $W_s$ . Theoretical value for (A)  $\rightarrow 100$ ; (B)  $\rightarrow 85.64$ ; (C)  $\rightarrow 64.07$ ; and (D)  $\rightarrow 76.34$ .

% of lithium sulphate, lithium nitrate and water respectively in the saturated solution, and  $S_2$ ,  $N_2$ ,  $W_2$  similarly in the accompanying wet residue, then the percentage of lithium sulphate in the solid phase denoted by  $S_1$  is given by

$$S_1 = \frac{S_2(W_1 - W_2) - S_2(W_2 - W_1)}{[W_1 - W_2]}$$

where  $W_1$  is the assumed value for water content in the solid phase. That particular assumption is considered valid in which the value  $S_1$  calculated as above nearly conforms to the theoretical requirement.

Table I, which is self-explanatory, gives some of the results obtained at 35°. Lithium sulphate monohydrate occupies virtually the entire field of saturation in the ternary system since the lithium nitrate content of the invariant solution almost coincides with the solubility of pure lithium nitrate itself. Microscopic examination of the solid phases also established that only lithium sulphate monohydrate was present. No evidence could be found for the presence of anhydrous lithium sulphate or of the double salts of Massink at 30° or 35°. Massink's deductions which might have been based on data obtained under non-equilibrium conditions appear to be erroneous. The mutual solubilities of lithium sulphate and nitrate were nearly the same at 30° and 35° owing to the slight change in the solubility of lithium sulphate with temperature.

The composition of the solid remaining in equilibrium with saturated solutions in the lithium nitrate field could not be directly determined in the ternary system because of its extremely limited range of existence. Donnan and Burt<sup>8</sup> reported that lithium nitrate trihydrate ( $\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$ ) melts congruently at 29.89°, but that its temperature of transition to another hydrate, namely, the semi-hydrate  $\text{LiNO}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$ , occurs at 29.60°. The semi-hydrate was found to undergo transition to the anhydrous salt at 61°. The authors reported the isolation of all the three salts. Massink loc cit. observed that anhydrous lithium nitrate persistently occurred as a solid phase in the ternary system at 35° and presumed it to be metastable with respect to the truly stable compound  $\text{LiNO}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$  which was formed only with great difficulty. Recently, however, Campbell<sup>9</sup> has doubted the existence of the semi-hydrate altogether. His dilatometric study on a lithium nitrate-water mixture containing water, in amount less than that present in  $\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$ , but more than sufficient to form the supposed  $\text{LiNO}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$ , gave only one break at 28.80. Further, he investigated the ternary

system " $[\text{LiNO}_3 - \text{NH}_4\text{NO}_3 - \text{H}_2\text{O}]$ " at 25°, 31°, 60° and 90° and observed the existence of anhydrous lithium nitrate as a saturating phase at all these temperatures. The semi-hydrate was completely absent in the system. Contrary to the observations of Donnan and Burt, the present work involving microscopic and visual examination of the crystals separating out during the evaporation of aqueous lithium nitrate solutions at different temperatures above 30° did not reveal any differences in shape or form. Direct chemical analysis of the crystals was ruled out because of their excessive deliquescent nature and the difficulty experienced in the complete removal of the adherent mother-liquor. A partial study of the ternary system " $[\text{LiNO}_3 - \text{NH}_4\text{NO}_3 - \text{H}_2\text{O}]$ " in the lithium nitrate saturation field containing low amounts of ammonium nitrate, was therefore made at 30°. Algebraic and geometric extrapolation of tie-lines confirmed the existence of only anhydrous lithium nitrate. Microscopic examination of the solid phase showed its identity with the crystals separating out of aqueous saturated solutions of pure lithium nitrate during evaporation at temperatures above 30°. Hence, it can be concluded that the semi-hydrate of lithium nitrate does not exist.

Full details of the investigation will be published elsewhere.

The author is deeply grateful to Prof. K. R. Krishnaswami for his keen interest in the work. Dept. of General Chem., G. ARAVAMUDAN, Indian Institute of Science, Bangalore, December 17, 1956.

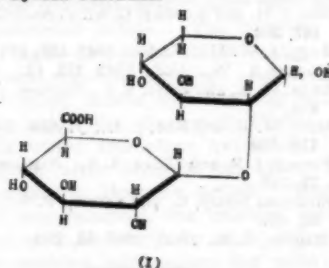
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#### THE ALDOBIOURONIC ACID FROM GROUNDNUT SHELL HEMICELLULOSE A<sub>1</sub>

GROUNDNUT shell hemicellulose A<sub>1</sub> gave on hydrolysis<sup>1</sup> with dilute acid a mixture of aldobiouronic acid (I), d-xylose and a small quantity of l-arabinose. The acidic component

which forms the subject of this communication, was separated from the hydrolysate as its barium salt and the free acid liberated through the use of a cation exchange resin. The acid on vigorous hydrolysis with 8% methanolic hydrogen chloride in a sealed tube at 112-115° C. followed by further mild hydrolysis yielded *d*-glucuronic acid and *d*-xylose as identified by paper chromatography and preparation of the usual derivatives. The products from the initial vigorous hydrolysis after being freed from hydrochloric acid, gave, on subsequent treatment with methanolic ammonia, the amide of methyl  $\alpha$ -*d*-glucuronoside, confirming the presence of *d*-glucuronic acid. After removal of the uronic acid derivative, the neutral sugar glycoside on further mild hydrolysis gave rise to crystalline *d*-xylose.

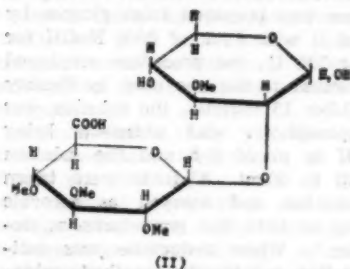
The methyl ester of the methyl glycoside of (I) when reduced with lithium-aluminium hydride,<sup>2,3</sup> till the naphthoresorcinol test was negative, yielded a disaccharide. This on hydrolysis with dilute acid, gave rise to crystalline *d*-glucose and *d*-xylose indicating that the aldobiouronic acid is composed of *d*-glucuronic acid and *d*-xylose residues.



The point of attachment of the *d*-glucuronic acid moiety to the *d*-xylose residue was inferred from a study of the methylated aldobiouronic acid (II) obtained during the hydrolysis of the fully methylated hemicellulose A<sub>1</sub> (unpublished work of the authors). The methylated acid (II) on further hydrolysis with 8% methanolic hydrogen chloride in a sealed tube at 112-115° C. and treatment of the resultant hydrogen chloride-free products with methanolic ammonia yielded a crystalline material identified as the amide of methyl 2:3:4-tri-*o*-methyl  $\alpha$ -*d*-glucuronoside.<sup>4</sup> The neutral component in the hydrolysate yielded on further mild treatment with acid 3-*o*-methyl *d*-xylose<sup>5</sup> indicating that the *d*-glucuronic acid moiety is linked to the *d*-xylose residue in the methylated aldobiouronic acid (II), and therefore, in the original aldobiouronic acid (I) through a position other than C<sub>2</sub>. As the C<sub>1</sub>

and C<sub>4</sub> positions of the *d*-xylose residue are usually linked to other *d*-xylose residues in the main chain of the hemicelluloses,<sup>6</sup> it would appear that the *d*-glucuronic acid unit is linked to *d*-xylose residue through the C<sub>3</sub> position of *d*-xylose.

In order to substantiate this deduction, the methylated aldobiouronic acid (II) was fully methylated and then submitted to hydrolysis. After removal of the acidic component, further hydrolysis of the neutral sugar residue yielded 3:4-di-*o*-methyl-*d*-xylose identified through its lactone.<sup>7</sup> Hence the fully methylated aldobiouronic acid derived from (II) is the methyl ester of methyl 2-*o*-(2:3:4-tri-*o*-methyl-*d*-glucuronosyl)-3:4-di-*o*-methyl-*d*-xyloside. The specific rotation ( $[\alpha]_D^{20} = +103$ ;  $c = 0.5, \text{CHCl}_3$ ), indicates that the close linkage may be of the  $\alpha$ -type. The aldobiouronic acid is, therefore, 2-*o*-(*d*-glucuronosyl)-*d*-xylose and has the formula (I). The observed equivalent weight (314) is in agreement with the formula given above. It may be noted that an aldobiouronic acid with a similar structure except in having a methoxy group on the C<sub>4</sub> position of the uronic acid residue has been



obtained from the straw of flax<sup>8</sup> (*Linum usitatissimum* sp.).

Full details of this work will be published elsewhere.

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December 3, 1956.

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# BEHAVIOUR OF REDUCTONE IN ASCORBIC ACID ESTIMATION

It is well known that reductones, which occur in stored food products, react like ascorbic acid in both the standard methods of determination of this vitamin, viz., the 2:6-dichlorophenol indophenol procedure due originally to Tillmans<sup>1</sup> and the 2:4-dinitrophenyl hydrazine method of Roe and Kuether.<sup>2</sup> Lugg,<sup>3</sup> Mapson,<sup>4</sup> and Snow and Zilva,<sup>5</sup> have tried to eliminate this interference by carrying out the titration in presence of formaldehyde. As far as the Roe and Kuether method is concerned, it is not yet possible to allow for reductones satisfactorily. Mills and Roe<sup>6</sup> have claimed that the colour due to reductones fades away largely in 30 minutes, and therefore in practice the colour is usually read after that interval.

However, it has been found that when appreciable quantities of reductones are present, a 30 minute interval for taking the reading is not adequate. A comparative study has therefore been made of the behaviour of reductone in both the methods to select the method of choice when ascorbic acid has to be estimated in the presence of reductones. For this purpose, reductone was prepared from glucose by heating 1 g. of it with 1 ml. of 20% NaOH for 15 minutes at 100°C., the procedure employed being quite similar to the one used by Penney and Zilva.<sup>7</sup> After 15 minutes, the solution was cooled, metaphosphoric acid added to bring down the pH to about 3.0 and the solution was made up to 50 ml. Aliquots were taken from this solution and assayed as ascorbic acid according to both the procedures as described earlier.<sup>8</sup> When reductone was estimated by the Roe and Kuether method, oxidation with bromine, followed by removal of the excess bromine by aeration, was also carried out, and the readings taken 30 minutes after development of the colour as suggested by earlier workers.<sup>2,6</sup> The comparative data are presented in Table I.

TABLE I

Ascorbic acid equivalents of gluco-reductone assayed according to the indophenol and dinitrophenylhydrazine procedures

Amount of reductone (ml. of solution)	Ascorbic acid equivalent (μg.)	
	Indophenol titration method	Roe and Kuether method
0.1	5.0	50.0
0.2	10.0	95.0

It may be seen from the results that of the two methods, the colorimetric method based on the reaction with dinitrophenylhydrazine is very much more susceptible to interference. It is suggested therefore, that the titration procedure, modified as indicated by earlier workers<sup>2-5</sup> should be the method of choice when it is desired to estimate ascorbic acid content in samples containing large amounts of the reductones. Further, where a part of the vitamin is suspected to exist in the oxidised form, as dehydroascorbic acid, total "vitamin C" will have to be determined after reduction with hydrogen sulphide, or with homocysteine as recently suggested.<sup>9</sup>

Our thanks are due to the University of Madras for permission to publish the above results which form part of a thesis for which one of us (K. S. S.) was awarded the M.Sc. Degree.

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## STEREOSPECIFIC INFLUENCE OF MOISTURE IN OXIDATION WITH SILVER ACETATE-IODINE

The use of silver benzoate and iodine in benzene medium for the oxidation of some naturally occurring unsaturated fatty acids to the corresponding dihydroxy derivatives was discussed in a recent paper.<sup>1</sup> It was reported that in these oxidations the use of a perfectly anhydrous medium gives the corresponding lower melting threo dihydroxy acid, whereas in presence of traces of moisture, the main product is the corresponding higher melting erythro dihydroxy acid.

The action of silver acetate-iodine on erucic acid and the influence of moisture on the reaction are herein recorded. Oxidation of erucic acid with silver acetate-iodine in acetic acid medium and hydrolysis of the resulting pro-



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duct gave 13,14-dihydroxy behenic acid in high yields, the yield being better than that when silver benzoate-iodine-benzene was used. When dry acetic acid was used, the product was predominantly the lower melting dihydroxy behenic acid whereas the use of wet acetic acid gave mainly the higher melting dihydroxy acid, the water present apparently causing the inversion. Thus this method of oxidation, on the basis of the above work as well as the investigations of Barkley and others,<sup>2</sup> Ginsburg<sup>3</sup> and Jefferies and Milligan,<sup>4</sup> seems to be of general application and can be used for the preparation of both the geometrically isomeric glycols from an unsymmetrical ethylenic compound.

**Oxidation of erucic acid, using dry acetic acid:** Glacial acetic acid (99.5%; B.D.H. Laboratory Reagent) 200 ml., was refluxed for 1 hr. with 6 ml. of acetic anhydride and a small quantity of chromic oxide.<sup>5</sup> This was then distilled, the first and last 40 ml. portions being rejected and the intermediate fraction being separately collected. Silver acetate and erucic acid were dried *in vacuo* over phosphorous pentoxide. To a mixture of 3.4 g. of erucic acid and 4 g. (excess) of silver acetate in 60 ml. of the purified acetic acid was added 2.5 g. of powdered iodine. The mixture was heated on the water-bath (80-90°) for 5 hr., with occasional vigorous shaking. After filtering free of silver iodide and washing with a little acetic acid, the combined filtrate was diluted with water and ether extracted. The residual liquid, after removal of ether, was saponified with 8% alcoholic potash. Most of the alcohol was removed, the mixture diluted and acidified with hydrochloric acid. After filtration and washing with water, the solid was crystallised from 95% alcohol. The product, on recrystallisation from alcohol, gave 1.3 g. of dihydroxy behenic acid with the melting range 95-115°, which apparently was a mixture of both forms of dihydroxy behenic acid. The alcoholic filtrates from both the crystallisations were combined, diluted and cooled in ice-chest. Filtration and crystallisation from ethyl acetate gave three-13, 14-dihydroxy behenic acid (0.9 g.), m.p. 96-99°. On recrystallisation, the m.p. was 98-100°; mixed with authentic specimen of three dihydroxy behenic acid obtained by performic acid oxidation of erucic acid m.p. was the same.

When the B.D.H. acetic acid was used without treatment with acetic anhydride, 2.0 g. of a mixture, m.p. 115-20° and 0.45 g. of the three-dihydroxy acid, m.p. 96-98° were respectively obtained.

**Oxidation, using wet acetic acid:** When the purified acetic acid (60 ml.) was used along with 1 ml. of water in the above oxidation, a single crystallisation of the resulting product from alcohol gave 2.6 g. of the dihydroxy acid, m.p. 128-29°, identified as erythro-13, 14-dihydroxy behenic acid by mixed m.p. with authentic specimen.

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#### EXTENT OF REMOVAL OF AMINO ACIDS FROM SEWAGE DURING TREATMENT BY DIFFERENT METHODS

It was recently observed that during purification of sewage by the activated sludge process, the amino acids in the sewage were concentrated in the sludge and the effluent was practically free from amino acids.<sup>1</sup> But there is no information on the extent of removal of amino acids from sewage during treatment by other methods.

A comparative study was therefore made of the amino acid composition of the effluents from (1) the septic tank at the Institute; (2) chemical precipitation and clarification of sewage using alum; (3) mechanical filtration, by drawing sewage through an unglazed porcelain tube; (4) biological filtration through different filters containing granite pieces, sand and sand fractions of different particle sizes (the filtration carried out as indicated earlier<sup>2</sup>); and (5) the effluents obtained from the natural purification of flowing sewage at Bangalore where the raw sewage discharged at the outfalls in the outskirts of the town flows down in open channels and purifies itself without any treatment.<sup>3</sup> The effluent from the activated sludge process, activated sludge and septic sludge were also examined at the same time for purposes of comparison. The determination of the amino acids was carried out using the circular paper chromatographic technique.<sup>4-6</sup>

The samples of sewage (from the sewage works at the Institute), which were used for the chemical clarification and for filtration, contained 0.36 to 1.01 mg. of free amino acids and



65.1 to 91.3 mg. of total amino acids (acid hydrolysate) per g. of the dried solids. The samples of town sewage as discharged at the outfalls at Bangalore contained 1.05 to 1.12 mg. of free amino acids and 116.4 to 128.1 mg. of total amino acids per g. of the solids. The amino acids present in the sewage samples were: cystine, lysine, histidine, arginine, serine, glycine, aspartic acid, threonine, glutamic acid, alanine, tyrosine, methionine, valine, phenylalanine, and leucines. The percentage removal of the free and total amino acids from sewage in each of the above treatments is given in Table I. The activated sludge contained 8.12 mg. of free amino acids and 254.5 mg. of total amino acids (acid hydrolysate) per g. of the solids; the corresponding figures for the septic sludge are 1.08 and 40.8.

TABLE I

Extent of removal of amino acids from sewage during different methods of treatment

(Results expressed as percentage on the basis of equal volumes of sewage and effluent)

Treatment	Percentage removal of amino acids	
	In the free form	Total (in the acid hydrolysate)
Effluents from:		
Septic tank ..	40.8	46.3
Chemical clarification (with alum)	52.2	66.9
Mechanical filtration (drawn through unglazed porcelain tube $\frac{1}{8}$ " thick and $\frac{3}{4}$ " internal dia.)	62.9	62.1
Biological filtration, filtered through:		
(i) granite pieces ( $\frac{1}{2}$ inch size)	52.4	40.3
(ii) sand (from a river bed) ..	88.1	85.3
(iii) sand (20-40 mesh sieves)	90.0	87.3
(iv) sand (40-60 mesh sieves)	95.2	93.5
(v) sand (60-100 mesh sieves)	86.2	85.8

The effluents from the activated sludge process and natural purification, viz., (i) sewage flowing down the land having a gradient of 1 in 50 (at 1.29 miles from the outfall) and (ii) sewage flowing down the land having a gradient of 1 in 100 (at 4.75 miles from the outfall) were practically free from amino acids.

Among the factors determining the extent of removal of amino acids from sewage in the purifying systems studied, the activity of the protozoa (which were found in much larger numbers in activated sludge and in the region of purification in the flowing sewage) appeared to be the most important.

The authors wish to thank Professor K. V. Giri for his keen interest in the work.

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## RESISTANCE OF SOME SPECIES OF COLEOPTEROUS STORE INSECTS TO CHEMICAL TREATMENT

THE common beetle pests of stored grains can be arranged in a definite order of resistance (or susceptibility) to contact insecticides. In a series of trials conducted in this laboratory with different strengths of DDT dissolved in kerosene oil (0.025 to 0.1%), either sprayed directly on the test insects or applied to surfaces on which the insects were allowed to walk, it was observed that the rates of mortality of the different species recorded at intervals of 24, 48 and 72 hours after treatment make it possible to arrange them in decreasing order of susceptibility as follows: *Bruchus*, *Sitophilus*, *Rhizopertha*, *Tribolium*, *Latheticus*.

This phenomenon is generally sought to be explained on the basis of the permeability of the cuticle, the nature of the cuticular lipoids, and the ability of the insecticide to penetrate the integument of the specific insect. Other factors like the relative activity of the concerned insect and the moisture content of the body have also been considered. Median lethal doses (M.L.D.) have been determined for certain species of insects in respect of various contact insecticides, and it has been concluded that the dosage of insecticide required is to be adjusted according to the weight of insects concerned.

In an attempt to shed more light on this question, the following procedure was adopted: 100 adult insects of different species were col-

TABLE I

Species	Fresh weight of 100 insects in g.	Loss of weight after 24 hours starvation in g.	% of		% lost out of		Order of suscepti- bility
			Dry Wt.	Moisture Content	Total Wt.	Moisture Content	
<i>Bruchus</i>	.. 0.2872	0.0052	44.4	55.6	1.8	3.25	1
<i>Sitophilus</i>	.. 0.1255	0.0048	48.4	51.6	3.8	7.4	2
<i>Rhizopertha</i>	.. 0.0980	0.0113	40.8	59.2	11.5	17.1	3
<i>Tribolium</i>	.. 0.1541	0.0180	48.2	51.8	9.0	17.3	4
<i>Lateticus</i>	.. 0.0700	0.0070	44.0	56.0	10.0	17.8	5

lected and carefully weighed. They were made to fast for 24 hours and weighed again to determine the weight lost by evaporation and other metabolic changes due to starvation. They were then put in an electric oven at 100°C. for a week to remove all traces of moisture. The dried insects were weighed again. Table I gives the details of these observations.

The following tentative conclusions can be drawn from these data: (1) Heavier species are less resistant than the lighter ones; i.e., the order of susceptibility is the same as given earlier with the exception of *Tribolium* in the present series; (2) The weights are approximately in conformity with the bulk of the concerned insects, i.e., the bigger insects are proportionately heavier than the smaller ones; (3) No correlation is possible between (a) the proportion of dry matter and water-content on the one hand, and (b) resistance on the other. (4) The loss in weight after 24 hours' starvation with reference to the body weight or the water-content roughly conforms to the order of 'resistance' among these species. This means that the more resistant species lose more weight and a greater portion of their water-content than the more susceptible ones. No attempt is made to explain the physiological significance of these observations.

Grateful thanks are due to Dr. M. Puttaduriah, Government Entomologist, for encouragement and advice.

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#### CYTOLOGY OF LYCOPODIUM

Precious cytological data of the genus<sup>1</sup> reveals that the basic chromosome number is not constant. The gametic number has only been studied by Manton,<sup>2</sup> and for the five species investigated, three different numbers, 24-25, 34 and 78 are reported. That less attention has been paid to this interesting group of plants is

evident from the fact that only 7 out of 180 species<sup>3</sup> have so far been reported by various workers.<sup>1</sup>

This report intends to record the preliminary cytological observations on four species of the genus following the usual acetocarmine squash technique. Prefixation with saturated aqueous solution of *p*-dichlorobenzene for about 1-2 hours has been found useful for shrinking the chromosomes. The course of meiosis in all the four species investigated is absolutely normal and there is an abundant production of seemingly normal and viable spores.

*Lycopodium clavatum* L. grows luxuriantly on exposed rocks at higher altitudes in the Eastern Himalayas, and the present material was collected from Tiger Hill (7,000 ft.) and Tonglu (9,000 ft.), in Darjeeling District. Cytologically the Himalayan material resembles the British one<sup>2</sup> and shows clear 34 bivalents at diakinesis (Fig. 1). The chromosomes are characteristic of the species and appear as wavy structures as also noted by Manton<sup>2</sup> for the species.



FIG. 1. Diakinesis in a spore mother cell of *Lycopodium clavatum* L. showing  $n = 34$ ,  $\times 1,180$ .

*L. nikense* Franchet et Savatier was collected by Dr. Hiroshi Ito from Sigakogen (prov. Sinano, Japan) in July 1955, and has kindly been sent to us on request along with three more species. The sample material reveals 34 bivalents

at Metaphase I. The chromosomes are much smaller and unlike *L. clavatum* L.

*L. setaceum* Ham. is not uncommon in the Eastern Himalayas, but is rather very rare in Darjeeling and could be located only once in Lebong Forests growing epiphytically. Very little material was fertile and in a dividing spore mother cell only a probable count of ca. 165-170 bivalents has been possible, due to the presence of a few loose paired chromosomes. The high chromosome number is comparable to that of *L. selago* L.<sup>2</sup>  $2n = > 260$  and the present species records the highest number in the genus making  $2n = \text{ca. } 330-340$ .

*L. lucidulum* Michx. In Northern India, the species is reported to occur throughout the Darjeeling and Sikkim Himalayas<sup>1</sup> at higher altitudes and the present material was collected from Senchal forests (8,000 ft.), Darjeeling, where it forms small erect clumps on sufficiently moist naked red clay soil. In quite a number of preparations, 132 bivalents have been counted at diakinesis (Fig. 2). Meiosis as



FIG. 2. Diakinesis in a spore mother cell of *Lycopodium lucidulum* Michx. showing  $n = 132$ ,  $\times 1,180$ .

stated earlier is perfectly regular. This number is rather interesting since it is a multiple of 11. In this connection it is pertinent to note that Harmsen (cf. Delay<sup>1</sup>) has found  $2n = 22$  in *L. complanatum* L. which is the lowest record (to date) for the genus and in 3 other species the somatic numbers are multiple of 11. Further it is very significant since this number or its multiple is found in species belonging to both the morphological series of the genus (solitary axillary sporangia v/s sporangia in quasi-catkins). In view of the above, it is reasonable to assume that the entire or a part of the series in the genus may have evolved from 11 by either aneuploidy or euploidy. Ninan<sup>5</sup> has already stressed that the number 11 is a primitive one.

It may be mentioned that in contrast to *Selaginella*,<sup>2,5</sup> polyploidy seems to have played a significant role in the speciation of the genus *Lycopodium*.

The authors wish to express their sincere thanks to Dr. Hiroshi Ito for the Japanese material.

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### TEMPERATURE EFFECT ON THE IN VIVO PRODUCTION OF FUSARIC ACID

Using a thermostatically controlled miniature glass-house,<sup>1</sup> the *in vivo* production of fusaric acid, a toxin/antibiotic produced by *Fusarium vasinfectum* Atk., has been studied at varying temperatures and reported hereunder. Cotton plants, Karunganni 2 (*Gossypium arboreum*) grown in sterilised and *F. vasinfectum* infested and uninfested soils were treated to varying temperatures, viz., 32.5°C., 35.0°C. and 37.5°C. ( $\pm 0.1^\circ\text{C}$ ). At the end of fourteen days, fusaric acid content of these plants was determined by the modified agar-cup technique developed in this laboratory.<sup>2</sup> Chromatographic studies of the  $\alpha$ -amino constituents of plants growing at the three different temperatures indicated the consistent presence of cystine at 37.5°C. and its absence at the two other lower temperatures. The disease incidence and the *in vivo* fusaric acid content of cotton plants grown under the three different temperatures are presented in Fig. 1.

While it is obvious that there is a progressive decrease in wilt with increasing temperatures, a gradual accumulation of detectable fusaric acid in plants was favoured by increasing temperatures. This behaviour can be explained in the light of our present knowledge on the role of heavy metals, particularly Fe<sup>3+</sup> which is known to potentiate lycoramasmin activity in excised shoots of tomato.<sup>3</sup> It is, therefore, quite possible to expect fusaric acid to behave in a manner analogous to lycoramasmin in its ability to chelate with Fe<sup>3+</sup> or any other metallic ions of the host. Since cystine has a strong chelating ability with free Fe of the host tissue,<sup>4</sup> it seems logical to expect a decreased toxicity of fusaric acid at 37.5°C., presumably due to the preferential

chelation of cystine liberated at 37.5° C., with free iron or any other metallic ions of the host rendering them unavailable for effective phytotoxicity of fusaric acid.

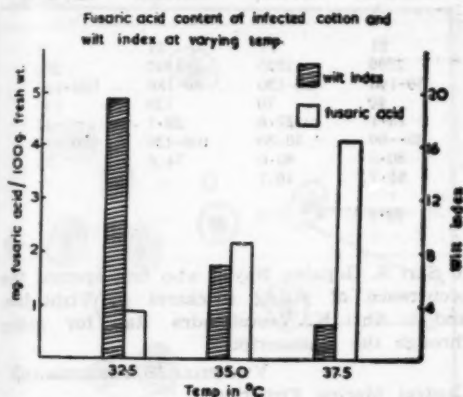


FIG. 1

Our knowledge of the changes of fusaric acid in tomato cuttings indicates that a major portion of this toxin is immediately metabolised in plants into various fractions, some of which are known to be more injurious to the host tissue than the unmetabolised fusaric acid.<sup>3</sup> Therefore, it is also quite possible that higher temperatures inhibit the formation of certain enzyme systems of the host responsible for the decarboxylation and N-methylation of fusaric acid with the result that a greater quantum of unmetabolised and less injurious free fusaric acid accumulates in the plants incubated at higher temperatures. An understanding of the quality of bound and free metallic ions available in the host at varying temperatures of incubation and the enzyme status of the host as well, is bound to throw considerable light on this problem and work on these lines is being pursued.

The authors are grateful to Professor T. S. Sadasivan and Dr. C. V. Subramanian for suggestions and criticisms.

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# OCCURRENCE OF LARVAE AND YOUNG MACKEREL (*RASTRELLIGER CANAGURTA* CUVIER) OFF VIZHINJAM, NEAR TRIVANDRUM

THIS note deals with the appearance of spawners, juveniles, young ones and post-larvae of the mackerel, *Rastrelliger canagurta* off Vizhinjam (near Trivandrum) from late March to early August in 1955 and early March to the end of August in 1956. Certain eggs believed to be of mackerel along with a few hatchlings have also been obtained from the plankton. Delsman<sup>1</sup> described mackerel eggs in 1926 but later expressed doubts about his earlier identification.

According to Devanesan and John<sup>2</sup> the spawning of mackerel begins about June and continues till September. Panikkar,<sup>3</sup> Chidambaram et al.,<sup>4</sup> Pradhan<sup>5</sup> and Sekharan<sup>6</sup> state that breeding starts from May or even April.

The smallest size of mackerel recorded on the West Coast, off Calicut is 40 mm. in June 1940.<sup>7</sup> On the East Coast, Rao and Basheeruddin<sup>8</sup> have observed 40-100 mm. stages off Madras in March-April 1953. Mackerel of 31 mm. size have also been observed by Rao from the Madras Coast in May 1955 (unpublished data).

Off Vizhinjam, during March-April 1955 and 1956, adult mackerel with ripe gonads (stages IV-VII) were obtained to the extent of 80% of the total number examined. The remaining ones were with spent gonads (stage VII). Spent ones continued to occur in the catches in May, June and July. Ova from the mature fish measure 0.6-0.84 mm. while the unshed ova in spent ovaries range from 0.81-0.84 mm. in diameter. Length frequency studies show that 88% of the adults belongs to the 220-240 mm. group with the 230 mm. group dominating. After July no mature or spent fish has been recorded. On the other hand, immature fish ranging from 180-200 mm. formed a small fishery in August 1956.

Juvenile (100-160 mm.) and very young mackerel (20-90 mm.) were found as stray specimens among shoals of white bait (*Anchoviella* spp.), and sometimes with silver-bellies (*Leiognathus* spp.) and rainbow-sardine (*Dussumieria* spp.) during March-August in 1955 and 1956. 27-50 mm. mackerel were first recorded at Vizhinjam from the shore-seine catches of 28th March 1955. Smaller mackerel measuring 24 mm. were subsequently collected in April. In 1956 a more intensive study was made. Table I shows the number of days when young fish appeared, the number measured and their size range.



TABLE I

Month	March	April	May	June	July	Aug.
Tackle	shore-seine	shore-seine	boat-seine	boat-seine	boat-seine	boat-seine
No. of days juveniles appeared	2	15	21	11	11	2
Number measured	83	1091	2296	1225	1297	200
Range of size in mm.	70-160	40-150	30-140	30-130	60-180	100-160
Dominant size in mm.	150	110	40	70	120	130
And its percentage	70	19.9	15.1	27.6	29.1	47
Range of dominant size groups in mm.	..	100-130	35-60	50-80	100-130	120-130
and their percentage	..	66.1	80.5	80.6	74.6	78
Percentage of size groups below 60 mm.	..	2.0	65.7	46.7	..	..
Percentage of size groups below 40 mm.	..	0.2	23.6	7.3	..	..

An analysis of length-frequency studies of the very young mackerel for the two years of 1955 and 1956 shows that specimens of 40-70 mm. are dominant in the samples of May and June, and those of 100-120 mm. in July. On the 21st and 23rd May 1956 when very young mackerel occurred in extremely large numbers, a closer examination revealed still smaller specimens and post-larvæ between 11 mm. and 25 mm. sticking to the *omals* (fish receptacles made of palmyrah leaves). In the specimens below 17 mm., the posterior finlets had not differentiated.

Plankton hauls made on the 23rd May 1956 on the spot where the fishermen were engaged in fishing showed pro-larvæ measuring 2.8 mm. and 5 mm. Hauls made in the 18-25 fathom area, off Vizhinjam, during all the months from March to May showed a few eggs of 0.84-1.009 mm. diameter which are tentatively assigned to mackerel. The identification requires confirmation. Attempts to rear the eggs have not been a success.

The fact that spawners, young mackerel and post-larvæ have been obtained at several places between Vizhinjam and Cape Comorin (Vizhinjam, Pulluvilla, Poovar, Kolachel, Muttom and Cape Comorin) proves that there is a spawning ground off this region. Since they are as yet found only in small numbers, they are probably stragglers from the main shoal and the actual spawning ground seems to lie beyond the present fishing area, which is confined to the 25 fathom limit within three miles from the shore. The earliest occurrence of a 27 mm.-larva on 28-3-1955 shows that the spawning starts much earlier than hitherto believed. The appearance of spent individuals in late July suggests that the period of breeding is probably prolonged.

I am grateful to Dr. N. K. Panikkar for his helpful criticism in the preparation of this note.

to Shri S. Gopalan Nayar who first spotted the occurrence of young mackerel at Vizhinjam and to Shri K. Veerabhadra Rao for going through the manuscript.

VYLOPILLI BALAKRISHNAN.

Central Marine Fisheries,  
Vizhinjam, Trivandrum,  
September 17, 1956.

\* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

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#### MORPHOLOGY AND COAGULATION TIME OF THE BLOOD CELLS OF *HETEROPNEUSTES FOSSILIS* (BLOCH)

IN *H. fossilis* the R.B.C. are mostly oval in form but a few of them are ellipsoid. They have a prominent nucleus and the nucleus is always placed centrally. In thin films and stained slides nucleolus was also seen. The cytoplasm occupied the whole space between the cell membrane and nucleus. It was noticed that like *O. punctatus* as observed by Dhar,<sup>1</sup> the size of the corpuscles varies to some extent, but the shape is more or less constant.

Though not much attention was paid to W.B.C., it was noticed that their number was very scanty as compared with R.B.C. in this fish. The total counts of blood cells per cubic mm. of blood are as follows: R.B.C. 25,00,000,



and W.B.C. II, 100. The ratio of R.B.C. to W.B.C. is about 235:1. The W.B.C. were almost round with or without granules in the cytoplasm. They also vary in size like the R.B.C.

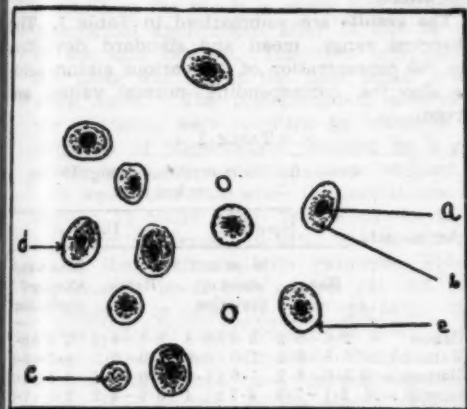


FIG. 1. Camera lucida of the blood cells of *H. fossilis*,  $\times 500$ . a, nucleus; b, cytoplasm; c, cell wall; d, R.B.C.; e, W.B.C.

The length of R.B.C. was studied in several preparations and it was found to vary from 5 to 13 Micra though in most of them the size varied from 8 to 13 Micra lengthwise and 9 to 11 Micra breadthwise. The size of the nucleus of R.B.C. was also measured which was found to vary from 3 to 4.66 Micra. The length of the W.B.C. was found to vary from 5.8 to 9.32 Micra lengthwise.

The fishes were starved to a maximum period of two months, even then no change was observed during any stage in this period in the majority of the R.B.C. But a few R.B.C. were found which varied in length from 18 to 23 Micra lengthwise and 13 to 16 Micra breadthwise and the length of the nucleus was always about 9 Micra.

To determine the coagulation time of the blood of this fish, a sensitive stopwatch and fine capillary glass tubes were used. It was performed at room temperature during May and June (92° F.) and in this case it was exactly 28 sec., which corresponds with the coagulation time of *O. punctatus* as observed by Dhar.<sup>1</sup>

The author wishes to acknowledge his gratitude to Dr. R. K. Sharan for his help and encouragement.

Dept. of Zoology,  
Science College,  
Patna, November 5, 1956.

V. BANERJEE

## USE OF RADIOACTIVE TRACERS IN THE STUDY OF POLLEN TUBE GROWTH

A KNOWLEDGE of the extent of pollen tube growth in the style is necessary for understanding the cause of failure of seed-set in self- and cross-incompatible combinations. Such information will be useful in devising means to overcome barriers to fertilisation which result from stigmatic inhibition of pollen germination or inadequate growth of the pollen tube in the style.<sup>1</sup> Pollen tube growth is usually studied by style dissection followed by suitable staining or by phase-contrast observations. In our studies in the genus *Nicotiana*, we found the following technique involving the use of radioactive isotopes like those of phosphorus (<sup>32</sup>P) or sulphur (<sup>35</sup>S), provides a rapid and reliable means of estimating the extent of pollen tube growth in incompatible crosses. A similar technique is described in a paper by Ar-Rushdi,<sup>2</sup> which appeared while the present study was under way.

The cross between *N. rustica* and *N. tabacum* succeeds if *rustica* is used as the pistillate parent but there is seldom any seed-set in the reciprocal cross. The style of *tabacum* is nearly thrice as long as that of *rustica* and we suspected that this difference in style length may contribute towards the failure of the cross in which *tabacum* is the pistillate parent. To ascertain this, some plants which had commenced flowering were transferred to glass jars containing  $\frac{1}{2}$  litre of Hoagland's Solution No. 1, without P or S while using <sup>32</sup>P and <sup>35</sup>S respectively. <sup>32</sup>P in the form of H<sub>2</sub>PO<sub>4</sub> or <sup>35</sup>S in the form of H<sub>2</sub>SO<sub>4</sub> was added to the nutrient solution at the rate of 1 millicurie per  $\frac{1}{2}$  litre of solution and the pH was adjusted to 5.8. The amount of radioactivity shown by the pollen of plants treated in this way was measured with a pocket battery monitor; the maximum activity (50 to 100 counts per second) was shown 3 days after treatment in the case of <sup>32</sup>P and 5 days in the case of <sup>35</sup>S.

Pollen from *rustica* and *tabacum* plants treated in this way were used to make reciprocal crosses, using control plants without any treatment as the pistillate parents. The styles from crosses as well as parents were collected 24, 48, 72 and 96 hours after pollination and were exposed to Ilford X-ray film for 120 hours. The autoradiographs thus taken are shown in Fig. 1. The autoradiographs indicated that *rustica* pollen did not grow beyond one-third of the length of *tabacum* style. This observation was independently confirmed in style dissection preparations made according to a

1. Dhar, R. P., *Proc. Zool. Sec., Bengal*, 1948, 1, 87.

modified schedule of Buchholz's method.<sup>3</sup> Thus the tracer technique provides a correct picture of the extent of pollen tube growth.

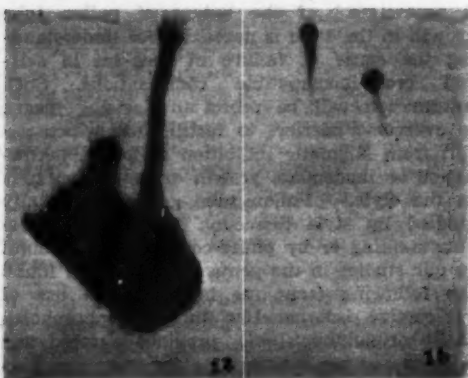


FIG. 1. (a) Ovary, style and stigma of *N. rustica* (left) and *N. tabacum* (right) plants grown in  $^{32}\text{P}$  solution. (b) Growth of *rustica* pollen tubes in *tabacum* styles, 72 hours after pollination. (Autoradiographs—Natural size.)

The dose of  $^{32}\text{P}$  and  $^{35}\text{S}$  added to the nutrient solution had no adverse effects on pollen fertility or functionability, as tested by germination in an agar-sucrose medium and stainability in aceto-carmin. Also, normal capsules with viable seeds could be obtained by selfing the flowers of treated plants. Though the absorption of  $^{32}\text{P}$  by the plants is better than  $^{35}\text{S}$ , it will be economical in such tracer studies to use  $^{35}\text{S}$  since it has a half-life of 87.1 days and different plants can be kept in the same solution one after the other.

We are indebted to Dr. B. P. Pal and Dr. S. M. Sikka for their encouragement and interest in the study.

Indian Agric. Res. M. S. SWAMINATHAN.

Inst., New Delhi, B. RADHAKRISHNA MURTY.  
November 16, 1956.

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### FREE AMINO-ACIDS IN ERYTHROCYTES IN DIABETES MELLITUS

THE effect of diabetes mellitus on the levels of free amino-acids in red cells, which appears to have been hitherto unexplored, was studied by the author and a brief report of the results obtained is presented here.

Twenty cases of diabetes mellitus (moderate to severe cases as shown by glucose tolerance

test) were studied. The details of the preparation of the sample and the subsequent paper chromatographic procedure for the estimation of the amino-acids have been described elsewhere.<sup>1,2</sup>

The results are summarised in Table I. The observed range, mean and standard deviation for the concentration of the various amino-acids as also the corresponding normal values are given.

TABLE I

Amino acid	Concentration in erythrocytes mg./100 ml. of packed cells			
	Normal		Diabetes	
	Range	Mean and standard deviation	Range	Mean and standard deviation
Alanine ..	2.6-5.2	3.6±0.8	2.5-4.2	3.2±0.7
Glutamine..	5.8-8.9	7.0±0.9	3.0-6.2	4.7±0.9
Glutamic acid	3.0-8.2	5.6±1.4	3.0-7.4	5.5±1.3
Aspartic acid	2.1-7.9	4.7±1.4	0.9-4.2	2.0±1.0
Glycine ..	1.6-3.2	2.2±0.4	2.0-3.3	2.4±0.4
Serine ..	1.2-1.8	1.5±0.2	1.0-1.9	1.5±0.2
Valine ..	2.1-3.2	2.6±0.4	1.6-2.9	2.3±0.4
Leucine ..	0.9-2.0	1.3±0.4	0.6-1.5	1.2±0.3
Isoleucine ..	0.4-1.0	0.8±0.2	0.4-1.4	0.8±0.4

It is seen that the concentrations of aspartic acid and glutamine in erythrocytes are markedly lowered while those of the rest do not seem to be appreciably affected.

Thanks are due to Dr. M. Sukumaran for his keen interest and to the Principal for facilities kindly provided.

Dept. of Biochemistry, G. Y. N. IYER.  
Medical College, Trivandrum-4,  
October 5, 1956.

1. Iyer, G. Y. N., *Indian J. Med. Res.*, 1956, **44**, 201.
2. —, *Ibid.*, 1957 (In press).

### SOME OBSERVATIONS OF THE CHEMICAL CONTROL OF SUGARCANE TOP-BORER *SCIRPOPHAGA NEVELLA* FEB., IN BIHAR

THE present note deals with the results of two micro-plot experiments conducted during 1955 in the insectary compound (where changes of natural interference by borers are remote) to study the potentialities of some of the newer insecticides in controlling top-borer damage.<sup>1,2</sup> The experiments were laid out in randomised blocks with three replications and plots of 6' × 6', the treatments being DDT (0.5%), BHC (0.5%), Cryolite (at 15 lb. per acre), Ryania (0.5%), Endrin (0.2%), Dieldrin (0.2%), Aldrin (0.2%), Toxaphene (0.5%), and Parathion (0.2%), all of which were applied at

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spray except Cryolite which was used as dust. Planting was done with 18 three-budded setts of B.O. 11 per plot while equal numbers of insectary hatched fresh top-borer larvæ were released on the plants in every plot followed by insecticidal applications after 12 and 30 hours of the said releases. Top-borer infestation in the plots was nil at the time larval releases were made. The post-treatment observations for incidence were recorded by complete enumeration of 'dead-hearts' induced as a result of the particular brood of larvæ released.

It was found that when the insecticides were applied 12 hours after release of larvæ, the minimum incidence (10.69%) has been recorded in the treatment with Parathion which is significantly lower than control (51.76%). This is followed in order by DDT (39.68%), Toxaphene (33.12%) and Endrin (32.42%). Of the other insecticides, Cryolite, Dieldrin, BHC, Ryania and Aldrin have proved significantly better than control. In the second experiment with insecticidal applications 30 hours after release of larvæ, the treatment differences have been non-significant, mean incidences ranging from 41.10 to 66.55%, thus suggesting the inefficacy of insecticidal applications after the larvæ have penetrated into the shoot and bringing into prominence the importance of timing the applications. It would appear that Parathion sprayed just at the hatching time of top-borer may prove effective in controlling this pest. Further confirmatory trials are in progress.

The work was conducted as part of the Sugarcane Research Scheme in Bihar, being financed jointly by the Government of Bihar and the Indian Central Sugarcane Committee to whom grateful thanks are due.

Central Sugarcane

A. R. PRASAD.

Res. Station,

S. N. PRASAD.

Pusa, Bihar, October 28, 1956.

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# CYTOLOGY OF RHODOBRYUM ROSEUM (WEIS) LIMPR. AND BRYUM ARGENTEUM HEDW.

*Bryum argenteum* Hedw. is one of the commonest mosses at Mussoorie, while *Rhodobryum roseum* (Weis) Limpr. grows luxuriantly at Bhillarua Khad and the road leading to Kempty Falls.

*Rhodobryum roseum* (Weis) Limpr. is dioecious. The gametophytes-bearing antheridia,

capsules and the young gametophores, regenerating from the male and female gametophytes, were fixed in acetic-alcohol (1:3) as also in propionic-alcohol (1:3). The latter fixative proved better for antheridial squashes.

In acetocarmine leaf squash ten chromosomes were counted at metaphase (polar view). The chromosomes are variable in size, nine being rod-like while the tenth, the Y chromosome, is dot-like and stains more deeply. Among the nine rod-shaped chromosomes, five are comparatively bigger than the other four (Fig. 1). These results were confirmed from propionic-carmine antheridial squash, but these chromosomes are comparatively smaller in size (Fig. 2). Ten chromosomes are also present in



(All Figs., × 1,070)

FIGS. 1-6. *Rhodobryum roseum* Weis Limpr. (1) 10 chromosomes; dot-shaped chromosome is the sex chromosome. (2) Antheridial squash. (3) Gametophore squash regenerating from the female plants. (4-5). Diakinesis showing 10 bivalents. H is the heteromorphic pair. (6) H is precocious in disjunction.

FIGS. 7-9. *Bryum argenteum* Hedw. (7) Antheridial squash showing 10 chromosomes; dot-shaped chromosome is the sex chromosome. (8) Diakinesis showing 10 bivalents. H is the heteromorphic pair. (9) Early anaphase.

acetocarmine squash of the gametophore regenerating from the female gametophyte, but all are rod-like and no dot-shaped chromosome is found. Evidently the dot-like chromosome is the sex chromosome (Fig. 3) as the regenerating gametophores keep the parental sex (details of regeneration will be published elsewhere).

In numerous acetocarmine capsule squashes ten bivalents were obtained at diakinesis and among these, one pair is clearly heteromorphic, one of its components being appreciably larger than the other (Figs. 4, 5). It is precocious in disjunction (Fig. 6). Among the remaining nine autosome pairs A, B and C are larger in

the descending order. A and C are in the form of thick rods, while B shows cross chiasma and D is intermediate in size. The remaining five are comparatively smaller in size. No laggards are observed where diad and tetrad nuclei are in the process of formation.

*Bryum argenteum* Hedw. is dioecious. Variable chromosome numbers have been reported for this species. Marchal<sup>1</sup> and Jachimsky<sup>2</sup> reported  $n=10$  for European material. Steer<sup>3</sup> reported  $n=12$  for Californian material of a variety *lanatum* Steere *et al.*, of this species, while the same author<sup>4</sup> reported  $n=11$  for arctic species.

In propionic-carminic antheridial squash of the material of *B. argenteum* collected from Mussoorie, ten chromosomes were counted at metaphase (polar view). The size of the chromosomes is variable, nine being rod-shaped and the tenth, Y chromosome is dot-like. Out of the nine rods, two are bigger than the rest (Fig. 7). In acetocarmine capsule squash at diakinesis ten bivalents including one heteromorphic pair were counted in a number of preparations; one of its components is appreciably larger than the other and apparently precocious in disjunction (Fig. 8). Fig. 9 shows an early anaphase stage where 20 univalents can be counted.

No laggards are observed where diad and tetrad nuclei are in the process of formation.

Dept. of Botany, NARINDER CHOPRA.  
Lucknow University,  
Lucknow, November 27, 1956.

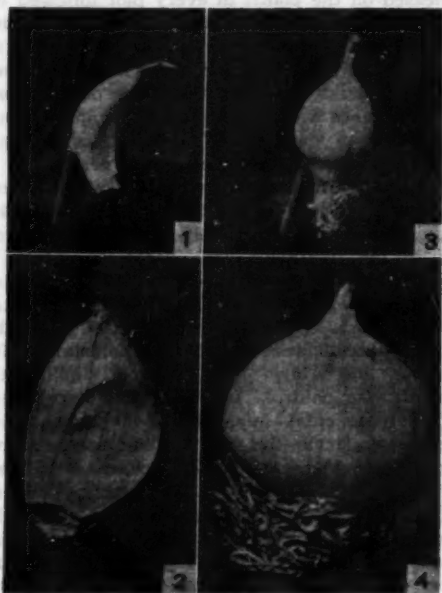
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### CHROMOSOME NUMBERS OF NORTH INDIAN GARLICS

GIGAS BULBS of garlic were collected by Mr. R. S. Chopra from Mussoorie vegetable market and these were kindly passed on to us for investigation. Later, a systematic search of Amritsar and Pathankot vegetable markets revealed that there are at least four apparently distinct types which are being sold as garlic, and a cytotaxonomical investigation of the material was undertaken.

The most common type possesses what may be called a compound bulb containing several small bulblets commonly called the 'cloves'. One such bulblet is shown in Fig. 1. This type has been persistently found to be diploid ( $2n=16$ ). The second type has also a compound bulb,

but is hexaploid ( $2n=48$ ). In this type there are only 4 to 6 bulblets in a bulb and each bulblet is gigas (Fig. 2) as compared to the first type (Fig. 1). The other two types possess



FIGS. 1-2. Bulblets from the compound bulb of the diploid (Fig. 1) and the hexaploid garlic (Fig. 2).

FIGS. 3-4. Simple bulbs of the diploid (Fig. 3) and the hexaploid garlics (Fig. 4). All approximately half the natural size.

simple bulbs. One of these is small (Fig. 3) and diploid while the other is much larger (Fig. 4) and hexaploid.

The hexaploid types flowered last spring under Amritsar conditions. The cause of their total sterility is being followed cytogenetically. Furthermore, the diploids and the hexaploids are being evaluated taxonomically and also for their agronomic properties and chemical content. It is pertinent to mention that the diploid with compound bulb is referable to *Allium sativum* Linn.

We would feel grateful to persons who would send us any variants which they come across during day-to-day use of this condiment.

We are grateful to Prof. P. N. Mehra, Mr. R. S. Chopra, Dr. Harbant Singh (Khalsa College) and Mr. R. S. Pathania for their valuable help.

Dept. of Botany,  
Panjab University,  
Amritsar, December 10, 1956.

T. N. KHOSHOO.  
V. B. SHARMA.



## REVIEWS

**Hi-Fi: From Microphone to Ear.** (*Modern Sound Recording and Reproduction Technique.*) By G. Slot. (Philips Technical Library Popular Series), 1956. [Available from Philips Electrical Co. (India) (Private), Ltd., 7, Justice Madhab Chandra Road, Calcutta], 1956. Pp. 169. Price Rs. 9-8-0.

Though popular interest in realistic recording and reproduction of sound is pretty high, there have been comparatively few books written on this fascinating subject. This, the latest addition to the popular series of the Philips Technical Library, is meant to fill this need and gives descriptions of sound recording and reproduction techniques so as to be understood both by lay readers and trained technicians.

The book, which is a translation from the original in Dutch, begins with a historical account of sound recording methods and surveys the translation from the purely mechanical to the complex mechano-electro-acoustical characteristics of the chain from the microphone to the human ear. The next chapter deals with disc cutting techniques and the processing of records for commercial use. The several types of pick-ups commonly employed are then discussed as also the causes of distortion that usually occur in disc recording. There is a chapter, useful to the layman, on how to take care of the needle and the record (disc) to get the maximum service out of these components. Record players and record changers are described next while the succeeding three chapters are concerned with amplifiers, loudspeakers and baffles. Magnetic tape recording occupies one chapter while some musical recordings which could roughly evaluate the quality of the reproducing equipment in the home are listed. The Appendix contains a loudness ratio chart, the frequency range of some musical instruments and the response characteristics of a few pick-ups manufactured by Philips.

As can be seen from the above summary, the book is mostly concerned with disc recording, presumably because this is the field of greatest interest to the author and also to the vast majority of the lay public, particularly outside the United States. However, in view of the rapidly increasing popularity of domestic tape recorders, it might have been useful to describe in more detail the techniques of magnetic recording. A description of methods developed

for mass duplication of tapes would be of interest to many readers. Further, the acoustics of recording studios and listening rooms, though briefly touched upon, could have been elaborated considering their decisive importance in the final assessment of quality. However, these are minor omissions and considering the difficult objective the author had set for himself, he has succeeded admirably in steering clear of being either too abstruse for the lay reader or too vague for the technician.

The get-up conforms to the usual high standards of the series, though there are more than a few printing mistakes in the text. Its reasonable price and easy availability would, it is hoped, make it popular both with the discriminating general public and those professionally interested in the subject.

RAM K. VEPA.

**Polythene—High Polymers.** Vol. XI. By R. A. V. Raff and J. B. Allison. (Koppers Company, Inc., Pittsburg, Pennsylvania) (Interscience Publishers), 1956. Pp. 551. Price \$16.00.

The volume is the eleventh in the series on high polymers and is welcome in view of the absence of information on polythylene in an organized form. The technical developments of this particular plastic discovered as early as 1935 have far outstripped the theoretical understanding. Commencing with the first chapter on historical development regarding the high pressure, high temperature polymerization methods of ethylene and on the erection of two large-scale production plants in U.S.A. in 1941, complete details of the properties and manufacture of ethylene, kinetic studies on the diverse types of polymerization of ethylene under catalysed and non-catalysed conditions, degradation, etc., have been reported in the next two chapters. Very interesting and instructive information is to be found on polythene chain grafting by various types of mono and diolefines, allyls, amines and on procedures for chlorination, chlorosulfonation for the after treatment of modified polythene. Molecular structure determination of polythene by electron microscope and molecular weight determinations by the usual ebullimetric and viscosity methods together with chain branching by infra-red spectrum are given.



A mine of information is to be found in Chapter VI on the diverse plastic properties of polythene. The chapters on analysis and testing, processing and handling, uses and applications of polythenes are very comprehensive and will be read with great interest by the fundamentalist and the technician as well. A statistical summary on consumption, production, uses and producers of polythene is an attractive novel feature of this book, which might be copied with advantage when works on other plastics are written.

The volume has a beautiful get-up and the number of illustrations are as numerous as they are pleasing, in every chapter. The rapid developments on the theoretical and industrial side of this versatile plastic are very nicely portrayed in the volume which will undoubtedly be read with great interest. M. SANTHAPPA.

**Germanium Diodes.** By S. D. Boon. (Philips Technical Library.) (Available from: Philips Electrical Co., 7, Justice Chandra Madhab Road, Calcutta 20), 1956. Pp. viii + 85.

The book under review is one of the popular series in Philips Technical Library. In about 85 pages, the author has presented an elementary and interesting account on germanium diodes which have become an important electronic component in recent years. The first four chapters are devoted to a popular exposition of the conducting properties of crystals and their diode characteristics. In the next four chapters, the behaviour of these diodes in actual circuits are discussed and the special features that distinguish them from thermionic valves in rectification and demodulation are explained with the aid of a number of well-chosen examples and graphs. The last chapter contains about twenty-five applications of this component in communication, measuring instruments and other electronic circuits. Complete data and characteristics of many of the germanium diodes of Philips manufacture are presented both in the appendix and text.

As mentioned in the preface, the author has discussed the basic nature and the electrical features of the device in a practical manner with the minimum essential theory. In the reviewer's opinion, a feature, important from either aspect, that has been omitted is their noise characteristic. However, engineers and scientists who would have occasion to design circuits involving crystal diodes would find this book useful in appreciating their correct application and operation.

K. S. CHANDRASEKARAN.

**Physics of Fully Ionized Gases.** By Lyman Spitzer, Jr. (Interscience Publishers), 1956. Pp. ix + 105. Price \$ 1.75.

This is a slim booklet of 105 pages included in the *Interscience Tracts on Physics and Astronomy*, edited by Professor R. E. Marshak.

The book deals in a theoretical way with the physics of gases composed of electrons and ions. Such gases occur in the earth's higher atmosphere, in the atmospheres of the sun and stars, and in some regions of interstellar space. The mass-movements in ionised gases are coupled to electromagnetic fields and their study has given rise to the growing subject of magneto-hydrodynamics or hydromagnetics.

There are five chapters in the book and an index. The first chapter deals with the microscopic motion of charged particles, the second and third with the macroscopic motion of neutral ion clouds, the fourth with waves in a plasma and the last with transport and diffusion phenomena which depend on encounters between charged particles in a rarefied gas.

The physical ideas are kept well in the foreground and the mathematics can be tackled by an Honours student in physics who is familiar with Maxwell's equations and with the elements of vector analysis and the kinetic theory of gases. The book will prove particularly useful to students of solar physics and of ionospheric physics.

K. R. R.

**Principles and Practice of Antibiotic Therapy.** By Henry Welch. (Published by Medical Encyclopedia Inc.), 1954. Pp. xix + 699. Price \$ 12.00.

Dr. Welch, as Director of the Division of Antibiotics of the U.S. Food and Drug Administration has been instrumental in the progress of antibiotics since their introduction into the U.S.A. The present volume is an enlarged and expanded edition of his earlier publication entitled "Antibiotic Therapy".

The volume is divided into three parts. Part I deals with the discovery, development and pharmacology of the antibiotics. Part II discusses the antibiotic therapy of infectious diseases. Part III deals with antibiotic therapy in medical specialties such as ophthalmology, pediatrics, oral surgery and dentistry. All the commonly used antibiotics have been exhaustively dealt with in the book under review, which merits careful study by scientific workers interested in antibiotics and by physicians using antibiotics in their daily work.

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The index, however, does not appear to have been prepared with sufficient care. For example, the important statement made on page 181, "The *in vitro* studies indicate that a clinical trial should be made using carbomycin in the treatment of amœbiasis, leishmaniasis and trypanosomiasis" will not be easily available to the student of leishmaniasis, as this condition does not find a place in the index at all.

K. S. S.

**Leukocytic Functions.** By A. S. Gordon and others. (*Annals of the New York Academy of Sciences*, Vol. 59, Art. 5. Pp. 665-1070), 1955.

This volume contains a series of papers which were discussed at a conference on 'Leukocytic Functions' dedicated to Dr. Hal Downey and held by the section of biology of the New York Academy of Sciences. Dr. Downey has spent half-a-century on the study of various aspects of hematology and has published several papers on the development of the spleen and lymph nodes, on the platelet problem and on the reaction of the blood and tissue cells to acid colloidal dyes.

The volume is divided into five parts, dealing with an introduction to the leukocytes, techniques in the study of leukocytic functions, factors influencing numbers, distribution and fate of leukocytes, defence functions of the leukocytes and chemical and metabolic aspects of leukocytic activity. It will thus be seen that the several facets of leukocytic functions with special reference to each variety of the leukocytes have been dealt with by the various contributors.

The papers dealing with physiologic functions of eosinophils, the daily rhythm in numbers of circulating eosinophils, hormonal influences upon the leukocytes and enzymes of leukocytes should be of special interest to Indian physicians who are struggling hard to find an acceptable solution to the problem of the pathogenesis of tropical eosinophilia or eosinophilic lung. Recent observations have shown that serotonin sharply potentiates the eosinophilic action of cortisone. Since serotonin is a substance known to be in relatively high concentration in nervous tissue, the possibility must not be ignored that it may be liberated under certain circumstances and exert a hormonal action. The volume under review will merit careful study by those engaged in researches on tropical eosinophilia and will perhaps serve to convince them that the solu-

tion is more likely to come from the biochemical than the bacteriological laboratory.

Many of the papers are well documented with charts and micro-photographs to illustrate the points made in the text. The volume must be read not only by the laboratory worker interested in hematological problems but also by the physician who will find in it much to help him in his clinical work.

K. S. S.

**Enzymes: Units of Biological Structure and Function.** Edited by O. H. Gaebler. (Henry Ford Hospital International Symposium), 1956. (Published by Academic Press, Inc., New York.) Pp. 624. Price \$12.00.

The proceedings of the international symposium on "Enzymes: Units of Biological Structure and Function" held at Henry Ford Hospital, Detroit, in November 1955, are recorded in this volume. This is one of the most informative books ever written on enzymes and it will long remain a leader in its field. The symposium satisfies to a very great extent the need for representatives of many scientific disciplines such as microbiology, genetics, physiology and pharmacology, biochemistry and biophysics, nutrition, etc., to come together and discuss the subject of enzymes.

In Part 1 on 'the origin of enzymes', the articles relate to the mechanism of enzyme induction, the role of enzymes in cellular differentiation and nucleic acids and enzyme synthesis. Part 2 pertains to the gene-enzyme relationship. The cell structure as related to enzymes is dealt with in Part 3. The intracellular physiology of the mitochondrion and other cytoplasmic structures, the administrative role of the genetic apparatus like the chromosomes and other nuclear products in the life of the cell, etc., are discussed under this topic. The enzymatic basis for physiological functions such as excretion, visual excitation, light emission and the participation of the actomyosin system in organised enzyme reactions are discussed in Part 4. Part 5 on cellular energy sources and Part 6 on the regulation of enzyme activity likewise contain articles of a remarkably high order and value. Two evening lectures delivered by Drs. Linus Pauling and Szent-Gyorgyi on 'the Future of Enzyme Research' and 'Mechano-Chemical Coupling in Muscle' respectively are thought-provoking. Especially the former is almost a scientific crystal ball, the speaker extrapolating the course of the enzymes far and wide into the future and

striking a very optimistic and encouraging note about the shape of things to come.

The informal tone of the discussions affords glimpses of the participant's personalities, some of whom delve into the exciting possibilities that are ahead in enzyme research. The contributions strike a balance between the basic and experimental approaches, thus bridging the gap from theory to experimental evidence, especially the articles on cell biology, hitherto considered as merely descriptive. The book is packed with information which is judiciously presented and will be equally useful to the advanced worker as well as the student. After going through this vast store-house of information one readily discerns that enzymology is fast entering into a state of healthy adolescence and is no more an infant science. The editing has been done in a most scholarly manner and regarding the printing and get-up of the book, suffice it to say it is another Academic Press volume.

K. V. GMR.

**Epidemic and Endemic Diarrheal Diseases of the Infant.** (*Annals of the New York Academy of Sciences*), 1956, 66, Art. 1. Pp. 3-320. Price \$ 3.50.

The diarrheal diseases of the infants still constitute a major group amongst the diseases responsible for infant mortality. This problem is more acute in the underdeveloped countries lacking in public health programmes and complete eradication is yet to be achieved even in the highly advanced countries.

The present monograph on the subject is a timely publication setting forth the advances made in our knowledge of the etiology, pathogenesis, diagnosis, specific therapy and prophylaxis of epidemic and endemic diseases of the infants in a concise manner, presenting at the same time the limitations in our knowledge and the challenging problems still awaiting solution. The volume contains contributions from research workers of different disciplines, virologists, bacteriologists, veterinarians and physicians, thus providing an unique opportunity to review a synthesis of thoughts rather than canalization into a restricted compass.

The initial chapters deal with a historical review and global appraisal of the diarrheal diseases in man by Hardy, and the prevalence of diarrheal diseases in animals by Hagan; Nungster describes the host parasite relationship and the importance of genetics and nutrition of the host in relation to susceptibility to infection is shown by Schneider. The immuno-

logical studies presented by Edsall and Gamma globulin deficiency in infancy by Spain et al. are of great interest in understanding the higher susceptibility of the infants to diarrheal infections.

A critical appraisal of the etiology of the diarrheal diseases, constitute the second group of papers. These include *Salmonella* and *Salmenellois*, *Enteropathogenic escheria coli* and their importance as causative organisms of diarrhoea, the role of *paracolonobacterium proteus* and *Clostridia* in the diarrheal diseases of man.

The improvements over the conventional diagnostic agglutination methods by the monovalent and polyvalent enterobacterial haemagglutination and the haemolytic modification of these tests and the potential usefulness of these methods for the diagnosis and epidemiological investigations of enterobacterial diarrheal diseases are described by Neter et al.

Besides the bacterial origin, the possibility that infantile diarrhoea might be caused by viruses has received considerable attention. There are a number of natural diarrheal diseases among animals that are caused by viruses. Epidemic diarrheal disease of viral origin of newborn calves, newborn swine, suckling mice, diarrhoea in puppies by distemper virus, *Miyagawanella bovis* infection in calves have been discussed in detail. These observations together with the identification of a new, large and heterogeneous group of many antigenically distinct viruses in the very young children have focussed attention and the possible role of poliomyelitis, Coxsackie, APC and ECHO viruses in various syndromes in which diarrhoea is a prominent clinical manifestation.

M. SIRSI.

**Journal of the Palaeontological Society of India, Vol. I, No. 1. Inaugural Number.** (The Palaeontological Society of India, Alimanzil, Walaquadar Road, Lucknow), 1956. Pp. xxxvi + 229. Price Rs. 30.

The inaugural number of the above journal contains 32 articles by distinguished scientists both Indian and foreign. Some of these are general introductions to problems in palaeontology. Others are articles on original work done by individual authors.

M. R. Sahni, the President of the Society, summarizes the various aims of the Society which include not only strictly scientific ends but also the aim of disseminating popular knowledge among the lay public. He also gives in the second article a fascinating review of





**New Record for Strength of Materials**

A new "world record" for the strength of metals has been established by metallurgists at the General Electric Research Laboratory, U.S.A. Recent modifications of General Electric's methods of making "perfect" iron crystals have produced tiny whiskers with tensile strengths as high as 1,900,000 psi, which is more than 150 times that of ordinary iron crystals and four times that of the strongest steel wire.

General Electric scientists first announced two years ago that they had made extremely strong iron whiskers. Subsequently these methods have been adapted to a variety of other metals, including gold, silver, platinum, nickel and copper. Copper crystals have been made with tensile strengths of 600,000 psi, twenty times as strong as ordinary annealed copper. The newest iron crystals have nearly twice the strength of those made earlier.

**Physiological Control of Population Growth**

In a recent letter in *Nature* (1956, 179, p. 992), W. K. Whitten observes that while mouse ova collected from the Fallopian tubes at the eight-cell stage develop to blastulae when cultivated in a purified medium, it has now been observed that if progesterone is added to this medium, all ova die when the concentration is 8 µg./ml. or more. The development of blastulae from tubal ova *in vitro* was also prevented by low concentrations (10 µg./ml.) of 'Triton' W.R. 1939 and other surface-active agents. In the presence of these substances, the blastomeres, which normally fuse to form a compact spheroidal mass, failed to do so and remained discrete and rounded.

But it was noticed that neither progesterone nor 'Triton' had any action on ova *in vivo*. This may be due to the failure of the substances to reach the lumen of the Fallopian tubes, and it is suggested that if this can be overcome, it may be possible to interrupt the course of pregnancy at the stage of oval cleavage.

**Agricultural Society, Calcutta**

At the General Meeting of the Society held recently, the following Office-bearers were elected for the year 1957: *President*: Prof. N. R. Dhar; *Vice-President*: Shri Debendra Nath Mitra; *Secretary-Treasurer*: Shri R. M. Datta; *Editor*: Prof. P. A. Sen.

**Indian Phytopathological Society, New Delhi**

At the Ninth Annual General Meeting of the Society held recently, the following Office-bearers were elected for the year 1957: *President*: Dr. B. L. Chona; *Vice-President*: Dr. R. K. Saksena; *Secretary-Treasurer*: Dr. R. Prasada (1956-58).

**Indian Botanical Society**

At the Thirty-Sixth Annual General Meeting of the Society held recently, the following Office-bearers were elected for the year 1957: *President*: Dr. S. K. Pande, Lucknow; *Vice-Presidents*: Dr. A. C. Joshi, Chandigarh; Dr. S. Ranjan, Allahabad; *Secretary*: Dr. J. Venkateswarlu, Waltair; *Editor-in-Chief*: Dr. T. S. Sadasivan.

**The Royal Society Commonwealth Bursary Awards**

Amongst the persons to whom the awards have been made are: Dr. V. R. Rao, Reader in Physics, Andhra University, India, to enable him to study spectroscopic techniques in cytology at King's College, London, and to Dr. S. Basu, Reader in Chemistry, University of Calcutta, to enable him to study the application of quantum mechanics to the solution of problems of chemical reactivity at Oxford.

**Award of Research Degree**

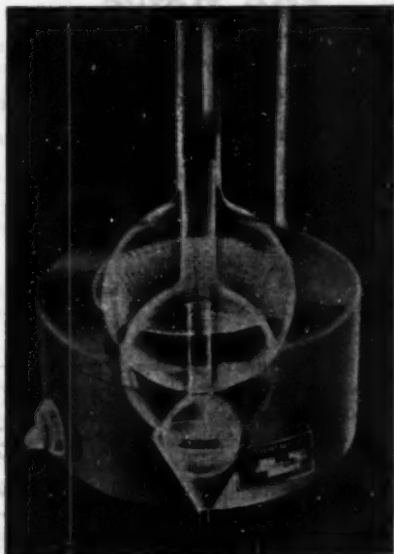
The University of Poona has awarded the Ph.D. Degree to the following candidates for theses indicated against each: Shri M. B. Deshmukh, "Some Studies in Joshi Effect" (Physics); Shri H. L. Bhatnagar, "Physico-Chemical Studies on Polymer Solutions" (Physical Chemistry); Shri C. M. Deshpande, "Dipole Moment and the Nature of the Chemical Bond" (Chemistry).

**CORRIGENDUM**

In the note on "Leafy Tuft Disease of Sugarcane", Vol. 26, p. 33, column 1, para 2, should be read as follows: The disease was first noted in May 1943 in Co. 604 at Pusa and has been under routine study because of its very rare occurrence in Bihar. Its symptoms were published by the author in 1951. (*Proc. 1st Bio. Conference Sug. Res. Workers*), etc.



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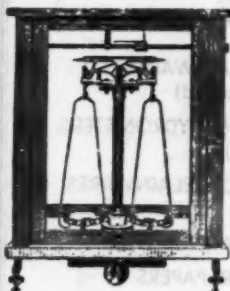
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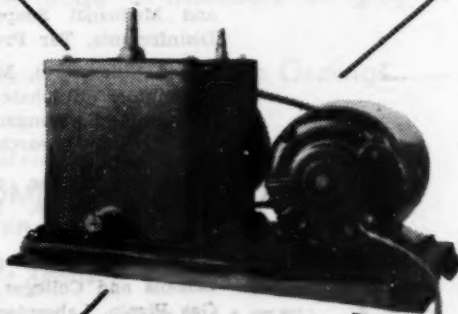
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